ALL ABOUT

GOLD, GEMS, AND PEARLS

(ALSO MINERALS GENERALLY)

IN

CEYLON AND SOUTHERN INDIA:

COMPILED

BY THE PUBLISHERS,

FROM A VARIETY OF

AVAILABLE AUTHORITIES,

WITH

SPECIAL REFERENCE TO MINING INDUSTRY, AS WELL AS TO THE EXTENSION OF THE PRESENT GEM-DIGGING, AND TO THE COMMENCEMENT OF A GOLD, ENTERPRISE IN CEYLON.

SECOND EDITION, GREATLY ENLARGED.

WITH TWO MAPS,

SHOWING THE PEARL FISHERY BANKS AND THE SITES OF THE GEM-DIGGING INDUSTRY AND GOLD EXPLORATIONS IN CEYLON.

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COLOMBO:

A. M. & J. FERGUSON.

LONDON:

JOHN HADDON & CO.; TRÜBNER & CO.; & GEO. STREET & CO.

1888.

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TN416
I4F4

Ceylon! Ceylon! 't is nought to me
  How thou wert known or named of old,
As Ophir, or Taprobane,
  By Hebrew king, or Grecian bold:—

To me thy spicy-wooded vales,
  Thy dusky sons, and jewels bright,
But image forth the far-famed tales—
  But seem a new Arabian night.

And when engirdled figures crave
  Heed to thy bosom's glittering store—
I see Aladdin in his cave;
  I follow Sindbad on the shore.

48373

MISS JEWSBURY.

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PREFACE TO THE FIRST EDITION.

—where the gorgeous East, with richest hand,
Showers on her kings barbaric pearl and gold.

When, at the request of several colonists, we began to reprint the information at our command in reference to the existence of "Gold in Ceylon," we had no intention of travelling beyond that particular subject or of publishing a pamphlet of more than fifty pages. By degrees, however, information grew on our hands which appeared to have a direct bearing on the best means of guiding prospectors to the development of Gold and other Mining industries in Ceylon, and it seemed a pity not to give it a place. Our attention was next called to the importance of the Gem-digging Enterprise as carried on chiefly in the Sabaragamuwa district; to the splendid opportunity presented for the development of this industry by means of European capital and appliances; and to the fact that very little was known in England or even among colonists here, respecting Ceylon gems or the primitive means adopted by the Sinhalese for their discovery and collection.

To make the *brochure* complete, we next resolved to reprint information respecting the Minerals and Geology generally of the island; giving special papers on Plumbago, the only mineral of commercial importance so far included in our export trade; and finally, in order to round off the list of precious things for which Lanka and Serendib have been famous from time immemorial, we have added the story of our "Pearl Fisheries," with all the facts and figures at our disposal.

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We regret that, from the circumstance of the work gradually growing as the printing went on, a systematic compilation could not be attempted, but we trust the full index will enable everyone to find what he wants, and that this little book may be of interest as well as of some service to all anxious to establish a Gold-mining industry, and to extend the Gem-digging enterprise in this

Utmost Indian isle, Taprobane.

THE PUBLISHERS.

COLOMBO, 24th June 1881.

NOTE TO THE SECOND EDITION.

Although, in a busy newspaper office, we have not had time to revise and compile the new matter methodically, yet our "Gold, Gems, Pearls, &c.," has now become a very considerable volume. Besides copious extracts from the pages of our *Tropical Agriculturist* and daily press we are also indebted to the pages of Streeter and of an exceedingly useful little American book entitled "Underground Treasures: How and Where to Find them," by JAMES ORTON, A.M.

Later information respecting the Pearl Fisheries and Geology of the Island is also given.

We trust this second and greatly enlarged edition will be even more appreciated than the first, owing more especially to the two useful Maps, prepared for us at the Surveyor-General's Office, with which it is accompanied.

A. M. & J. FERGUSON.

COLOMBO, FEBRUARY 1888.

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Gold in Ceylon.

GOLD MINING IN INDIA—WHY NOT IN CEYLON?

(From the "Ceylon Observer" in 1881.)

We believe there is as good *prima facie* evidence of profitable quartz reefs existing in our hill-country as there was in regard to Wynaad when gold-mining companies began to be established for that region. The time has, therefore, come for practical systematic investigation in Ceylon, conducted by men who know their business as gold-miners and quartz diggers, guided as far as is necessary by the scientific geologist. Some time ago we mentioned that gentlemen connected with the Lanka Plantations Company in London were interesting themselves in the question of "Gold in Ceylon," and that under their auspices, possibly, Mr. Brough Smyth might be asked to visit and report. Already, we believe, Mr. Smyth has given an opinion favourable to the probability of the gold-yielding reef cropping up in our hill-country, and it seems to us likely that all that this gentleman would have to do would be to set practical miners to work, to sink trial shafts, just where the information we already possess, points out to be most advisable. In other words we are almost past the preliminary and reporting stage in Ceylon, and if a couple of intelligent, practical miners were now on the spot—men of the type we found busy sinking shafts in search of gold near Albany, Western Australia, six years ago—they would speedily fix on the spot where a trial shaft ought to be sunk. Some desultory experiments and blasting for gold have, we believe, been carried on for some time in the neighbourhood of Galle; and Mr. A. C. Dixon's attention has been specially called to the subject. Not much encouragement has been afforded here so far, we believe; Mr. Dixon is shortly expected to sum up and make public the result of his observations. But we are not at all dependent on "modern evidences" to convince those whom we wish to influence to action that there is "a good case" for gold in paying quantities in Ceylon, and that it is the duty of the Government to cause a practical investigation to be made as soon as possible.

To go back to the beginning: the early inhabitants of Ceylon were not ignorant of the presence of gold. Its occurrence on a certain occasion is recorded in the "Mahâwansa." It has been frequently found in minute particles in the

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beds of several of our rivers, and we have only to point to such names as Ruwanwella, "Ranwella" "golden sand"; and "Rangala" "the rock of gold" in proof of the discovery of the precious metal at these places from time immemorial. Very little attention was, however, paid to this circumstance in modern times until after the discovery of gold in Australia and the great rush to the diggings there, set men's minds everywhere on the question of finding gold. It was in March 1854—twenty-seven years ago—that men with experience in Australia, coming here in a calling vessel, began to prospect in the bed of the Maha Oya, 30 miles east of Colombo, and very speedily they reported "gold." The excitement caused was considerable, but very far from pleasurable to the majority of the colonists. In those days when planters had all the land before them where to choose, and a sufficiency of labour and cheap transport were the only requirements to ensure a speedy fortune, it was perhaps no wonder that the planting community should learn with dismay of the chance of gold-diggings being opened in their neighbourhood, with a rush of all the "rowdyism" within reach, the probable demoralization of their labourers (already too few), and the upsetting of all their transport arrangements. So far from welcoming the news of "gold" in 1854, the most influential section of the community distinctly deprecated it and threw cold water upon it—one reason perhaps why the exploration was not continued to a permanently successful issue.

However that may be, a reference to our files for the year already mentioned shews that for a good many weeks such headings as the following in prominent black type were very common over our "news reports":—

"GOLD IN CEYLON."

LATEST GOLD NEWS.

THE "OBSERVER'S" GOLD INTELLIGENCE.

But perhaps the best way to convince the sceptical is to republish the following authentic official notice, which excited a good deal of adverse comment at the time as a piece of rather sharp practice, seeing that the work of exploration had not closed:—

Government have issued the following Proclamation:—

"In continuation of the Notice issued from this Office on the 14th instant, the Public are hereby informed, that His Excellency the Governor has been pleased to appoint T. C. Power, Esq., Assistant Government Agent of Kurunegala, to be Special Commissioner for the issue of Licenses to Dig, Search for, and Remove Gold, on any land belonging to the Crown according to the annexed form.

A fee of Ten shillings will be payable on every License so issued, which will remain in force for one month from the date of issue.

By His Excellency's Command,

C. J. MACCARTHY., Col. Secy.

Colonial Secretary's Office, Colombo, March 17th, 1854.

No. 1854.

The bearer having paid to me the sum of

on account of the Land Revenue, I hereby license him to dig, search for, and remove Gold on and from any such Crown Land within the Province, as I shall assign to him for that purpose during the month of 1854.

This License must be produced whenever demanded by me or any other person acting under the authority of Government."

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In our overland summary of 25th March 1854, the actual work accomplished so far was summed up as follows:—

The Gold Discovery announced in our last has continued to engross the attention of the Public and the Press, and in our columns will be found all the information and much of the discussion to which it has given rise. The result seems to be that Ceylon numbers Gold amongst her Mineral products, although not in quantities to render the search for it remunerative, or pleasant in such a climate as ours. The scene of the Diggings is in the bed of the Maha Oya whose sources and tributaries rise amidst the Dolosbage and Kadugannawa Groups of Coffee Estates: while not far from its embouchure in the neighbourhood of Negombo are tracts of Coconut and Cinnamon cultivation. Curiously enough Girooella in the neighbourhood of the Diggings is the spot where Dr. Davy closed those journeyings, one of the results of which he authoritatively declared to be that no Gold existed in Ceylon. Bennett combatted this opinion. Dr. Gygax, it appears, found traces of Gold in Saffragam, and Dr. Kelaart stated recently that some grains had been discovered at Nuwara Eliya. To the latter gentleman we owe the information that Mr. Hopkins, a great authority in Gold Mining, touched at Galle and pronounced it as his opinion that though Gold might be found in small quantities no profitable Diggings could be expected. The "practical" Diggers entertain a different opinion, but the results hitherto are in favour of the less sanguine view. Disease has already attacked the Diggers and within the last few days rains have set in which will probably put a sudden stop to their operations. The Maha Oya and many other rivers in Ceylon very nearly resemble those of Australia—their beds, which are nearly dry in the hot season, filling up rapidly when rains fall as they do in the Hills at the rate of 5 or 6 inches in a day. The result of a "prospecting" tour towards the Hills on the part of Mr. T. Power, accompanied by Drs. Ellery and Bradley, seems to be that auriferous sand been found in the bed of the Hingool Oya, a tributary of the Maha Oya, and in the bed of the Main Stream about 40 miles up from the original discovery near Girooella; but we hear of no nuggets even at that near point to the Hilly Ranges. Further search must now be stopped by the heavy rains which have fallen. In view of the result to which the search for Gold seems tending, Government have rendered themselves the subjects of much jocular remark by the issue of solemn Proclamations vindicating the rights of the Crown and forbidding all persons to dig without a License—a Special Gold Commissioner being appointed to grant such License at 10s a month. No Licenses have as yet been applied for, we believe.

Passing over details, we come to the next summary—April 11th—by which time the excitement and exploration (in consequence of heavy rain and bad fever) had pretty well subsided—and accordingly here is what was said:—

We cannot yet number Gold amongst our exports, the furor consequent on the discovery of flakes of metal in the Maha Oya having subsided as rapidly as it arose. The duty of a public Journalist in such a case is to collect and lay before his readers all the information possible. This we did, taking no oversanguine view of the possible result but the contrary. We are, therefore, not open to the animadversions of certain sage writers who can preach very wisely to those who do not need their teaching. The fact has been established that Gold exists in the rivers of Ceylon, but sickness and the rains have prevented such a thorough search as would settle definitively the question of quantity. A thorough exploration of the country with reference not only to Gold but to other Minerals and Metals is a highly desirable measure and one more worthy of Government than the issue of repressive proclamations.

Previous to this, the *Observer* had to take special pains to reassure the planters, many of whom are described as in an anxious state of suspense, lest gold-digging should be established as a rival to coffee-planting. They seem to have been greatly relieved when sickness drove the explorers away with so poor a return in

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actual value for their labours that no one had the courage to renew the search in the next dry season. Subsequently on June 22nd, the following reference was made:—

It is rumoured that Gold in considerable quantity has been discovered in Nuwara Eliya.

But there again the digging was soon after discontinued, and at a time when coffee planting was comparatively in its infancy and offered all possible scope for energy and capital, the enquiry after gold, as might be expected dropped out of view.

Now what we wish to point out is that in 1854 there was no idea of working on the reef. Quartz crushing at that time was comparatively unknown even in Australia. Deep shafts running down hundreds of feet into the bowels of the earth, such as we visited in 1869 at Ballarat, were not thought of fifteen years previously. Surface washing and pit digging alone commanded attention, and it is no wonder, therefore, that Ceylon was abandoned as an unprofitable field for such operations. Since then it is not too much to say, that the work of gold-mining has been entirely revolutionized, and it is the application of modern machinery for blasting, crushing and extracting gold from quartz that alone renders it possible to mine with profit in Southern India. There, as in Ceylon, the hopes of all concerned depend on quartz reefs, and we have abundance of evidence to shew that the work of the practical miner in our local auriferous region would probably be crowned with success. Not in the Southern, but along the western slopes of the Central Province—in the Kadugannawa, Kegalla and Dolosbage districts *par excellence*—ought the trial to be made. Mr. Brough Smyth in his official Report to the Madras Government of October 1879 estimated the cost of crushing quartz at 9s 6d per ton. This is based on actual experience, steam-power being, however, allowed for, while if water could be made the motive power (as is being done in Wynaad and no doubt would be the case here) a saving would be effected. One of the Wynaad mines even with inferior machinery has been actually worked at R6 per ton, and gold being reckoned at R2 per dwt. (and twenty dwts. to the oz.), three pennyweights would cover the cost, while one oz. of gold to the ton of quartz—considered a moderate estimate—would yield a profit of R34 per ton. The quantity of work done depends on the number and weight of "stampers" used, and here is how Mr. Brough Smyth works out the operation:—

10 stampers costing £5,000 inclusive of cost of erection and building, will crush 25 tons in the 24 hours; 40 stampers, costing £20,000 will crush 100 tons. Then 100 tons at a gold profit of R34 per ton = 3,400 per day, and in 300 working days = 10,20,000 per annum.

If, however, the estimate is reduced to ½ oz. per ton, the result would still be a profit equal to 35 per cent on the capital invested. As to yield the average experience gained in Australia for the 16 years ending 1876 was 11¼ dwts. per ton, but it is believed that the quartz in some portions of the Mysore and Wynaad (and why not Ceylon?) districts is richer than that of Australia. Already one Indian Company have extracted 40 ounces from 44 tons of ore, and that with very indifferent machinery. We have, therefore, good reason for saying that the time has come for Government to cause a sufficient examination to be made of the gold-yielding region of Ceylon—more particularly in Kadugannawa and Dolosbage. Mr. Brough Smyth will shortly return from Australia to India accompanied by practical miners, and would it not be well for Lieutenant-Governor Douglas to ask the Madras Government beforehand that Mr. Smyth should be allowed to visit and report on the local region referred to before he continues his journey from Galle to Madras? Possibly he might detach one or two miners to carry on the necessary exploration. It cannot now be pleaded that there is a want of money—that our revenue is likely to be short of the estimate. We may base the claim for expenditure on gold exploration or trial mining and crushing on the Pearl Fishery surplus alone. The official estimate is R400,000 from this source. Surely, Mr. Douglas will not grudge a small

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"From the real investment of capital in India, notwithstanding much loss, a fair return to this country may be expected. Machinery makes a market for portion of the surplus which will shortly be shewn (according to general expectation) to the work we have pointed out. It remains for the merchants and planters interested to say whether a public meeting should be held with the view of urging Government to comply with the request to ask for Mr. Brough Smyth's services to examine and report. Possibly Mr. Dixon might be able to do all that is needful by way of preliminary geological enquiry; but Mr. Smyth is so well-known in the Gold-mining world from his official position in Victoria, that his report would have the highest possible authority one way or the other, and would, we have little doubt, be well worth all the money spent on it.

GOLD IN SOUTHERN INDIA AND CEYLON:

We had only passed our remarks of yesterday to the printer when, by a rather noteworthy coincidence, we received a communication from a gentleman now engaged in surveying several of the Travancore plantations for quartz reefs. Some weeks ago in noticing the latest Report of the Aberdeenshire Agricultural Association we alluded to the valuable work done for farmers in the North of Scotland by their Consulting Chemists, Mr. Thomas Jamieson and Mr. J. MacDonald Cameron. We had no idea then that the letter gentleman was in India advising our brethren across the water on the Travancore hills as to the prospect of a gold-yielding reef being found in their properties, and also on the best means of improving their cultivation where coffee and other products were likely to pay better than gold-mining. Mr. MacDonald Cameron was commissioned in November last by a syndicate of coffee planters to proceed to Travancore to survey several of the estates for quartz reefs. This mission has been, in some cases, attended with very great success, but to what extent particularly, our informant is not permitted to say. But it has struck Mr. Cameron while working in Travancore that the planters in some of our Ceylon districts where old coffee is in rather a bad way might think it worth their while to ascertain the mineral resources of their estates, and, as he will be in Colombo early next month on his way home, they would have a good opportunity of conferring with him on the subject. As Mr. Cameron is certain to call at this office immediately he arrives, we shall be glad to receive any communications intended for him. He was Assistant for some time in the Royal School of Mines, South Kensington.

Besides reporting on the quartz reef, Mr. Cameron has taken advantage of his visit to Travancore to impress upon the planters the desirability of their establishing experimental stations to get the full benefit of chemical science in aiding their industry, if they are to continue to hope for the recovery of the capital invested in what, for the past few years at least, has not been a very successful pursuit. This suggestion is now under the consideration of the Committee of the Travancore Planters' Association, and will be definitely settled next week. The time has surely come for Ceylon, which has almost been foremost in coffee cultivation, to adopt a similar course, and it may be a question at this moment for the consideration of the Committee of our Planters' Association whether three or four experimental stations should not be established and worked in correspondence with those in Travancore under the direction of the same chemist. Such a course would, at least, have the advantage of lessening the cost. For a proof of the resulting benefit, we need only point to the letter of Mr. Graham Anderson of Mysore, who is really carrying on an experimental station for the benefit of his brother planters in India and Ceylon. When Mr. Cameron arrives we shall have to learn the minimum cost and other particalars of the experimental stations he would recommend, because it is possible that each of our larger districts, or even a divisional group of proprietors, might wish to carry on an experimental piece of cultivation under scientific

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direction. Mr. Cameron has already done good work both in England and Scotland in developing and promoting scientific agriculture, and in this respect, as well as in connection with the examination of quartz reefs, we trust his visit in Ceylon will not be without results.

At the same time, and whatever advantage may be taken by private individuals or public Associations of Mr. Cameron's services, we do not think that the proposal to secure Mr. Brough Smyth and his practical miners to report on our auriferous region should be lost sight of by His Excellency the Lieut.-Governor. Mr. Smyth's prolonged connection with the Victoria Government and his engagement with the Madras Government afford special reasons why the Ceylon Government, if it moves in the matter at all, as we hope it may, should endeavour to secure his services.

As regards "Gold in India," we may quote as follows from a letter received yesterday from a correspondent at Tellicherry:—

"Mr. J. D. Massey (formerly of Kandy) has been busy in the Wynaad reporting and reef-testing for English brokers and Directors of Gold Mining Companies. Nothing but 'gold, gold,' talked of over here, and it's not all mere talk, but actual results. A friend has sold half his coffee estate for an enormous sum—over £60,000 it is said!—but the coffee is of little use, the attraction being a splendid reef running through it."

With reference to gold in Ceylon we notice that in Nov. 1868 a find of gold nuggets in the Sabaragamuwa district excited attention, and was referred to in the *Observer* as follows:—

"At the moment there is considerable excitement created at the report of what looks like a real gold discovery in Saffragam, the district which has been ever famous for its gems, Ratnapura, the name of its chief town, indeed, signifying 'the city of rubies.' The quality of the nuggets brought to Colombo is of the very finest. The only question is one of quantity, and it is quite possible that, in the lower strata of rocks, gold as well as gem-bearing quartz may be found in abundance. Did time permit the probable effects of a profitable gold field in Ceylon might afford matter for interesting speculation.

"Real nuggets have been found by a 'gemming' party in Saffragam. The pieces which have reached the Kachcheri are from $\frac{1}{8}$ to $\frac{3}{8}$ of an inch in length, of various breadths, flattened and much like specimens from New Zealand. A mass of the weight of half a sovereign, tested as true gold has been melted from the nuggets and is declared to be 22 carats—better than sovereign gold."

We have been asked to republish in pamphlet form all the information given in the *Observer* during 1854 respecting the exploration and prospecting for gold, and we shall at once proceed to comply with the request, adding one or two useful papers on "How to find gold," and cognate subjects. Some of the results of a development of Gold-mining enterprise in India, and to a great extent in Ceylon, may be seen from the following extracts from Mr. Hyde Clarke's paper on "Gold in India":—

"So far as concerns the Indian gold, the districts now under consideration are in a hill region, subject to a very heavy rainfall. This is carried off by streams, and in some parts will not be available, and cannot be founded or secured by bends. There are, however, estates where streams, and in other districts storage, are available for water. In fact, India in these respects has advantages equal to most portions of the Californian regions, and beyond Australia. There are few parts of New Zealand better provided, nor are there in Brazil.

"Thus, where an estate has a good reef on it, and the water well laid on, the prospects may be looked upon as hopeful. Still, there will be vicissitudes, a season of short rainfall, the bursting of dams, and various incidents, which may interrupt steady working.

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other machinery, and so does the supply of engineering workmen to a country. With a large number of such men attached to the mines, it may become possible to introduce and use other machinery not otherwise available. The expenditure for wages is not likely to be excessive, it will check itself, as when found unremunerative, it will be stopped. Even the large salaries of superintendents and skilled officers cannot be a total loss to us, as many of these men will remain and open up other enterprise. A very good example of this is given in the *St. James's Gazette* of this evening. In consequence of the increase of machinery in the Linares lead district of Spain, the olive growers have taken to the purchase of improved machinery, instead of the old wooden old presses. It will be noted that the Belgium manufacturers, having got into the district, obtained the benefit of this new business.

"Although rather a speculative mode of regarding that and other such operations, it is a true one that whatever the direct result, there must be a gain from introducing into India, Englishmen of intelligence and enterprise. Such considerations are entitled to particular weight, when we come to regard the national relations of such undertakings. It may be said, indeed, we are hedged against loss in a material point of view. It is in this respect that England, in the long run, is found, not to have been a loser in the many disastrous ventures in gold mines of fifty years ago. The internal losses were very painful to many over-speculative persons, but in the event, the country was no loser.

"Although here was some loss in Brazilian mines, yet others give a return, and in the end we have got hold on the produce of Brazil, which has, in all kinds of ways, been a benefit to us.

"In fact, it is from no single set of figures that the real influence and value of such operations can be determined, and they must be examined as a whole, and in their full results, with all their losses and all their gains. These the balance-sheet of a mining company will not disclose, as it will not shew the effective distribution of capital. There may be loss to the shareholders and gain to the manufacturer and the merchant.

"A very important consideration is the supply of labour. The want or failure of this has put a stop to mineral industry in many countries. Thus, in Brazil, in the Portuguese time, the numerous and productive mines of the auriferous districts depended on slave labour. With the emancipation of the negroes, whole districts were thrown out of yield, and it is only by close attention that labour has been obtained for the St. John del Rey mines, and the large dividends have been kept up. The supply of labour must be free and continuous, and consist of men who are disposed to engage in such a pursuit. This is the strength of Chili, where the natives are content to undergo the drudgery, and receive regular wages, or as tributers, run their chance of the prizes of rich and casual finds.

It is likewise necessary to have English or other foreign miners, who understand the business, are willing to go abroad, and encounter with or without their families, the vicissitudes of distant travel. So far as this population is concerned, we have it at home in Cornwall and Wales, whence many proceed, not only to English countries in Australia, South Africa, Canada and the United States, but to foreign lands. They are as familiar with the hot climates of Brazil, Chili, and Mexico, as with any of the regions they frequent. Then there are our Australians. There would, consequently, be no difficulty in obtaining a supply of workmen for our Indian Empire, where they are under English protection. The same circumstance will favour in case of need, the introduction of foreign miners. The mass of the labour, however, will be local.

Our own people are well acquainted with gold mining in Australia, New Zealand, California, Brazil, and Columbia, and it is not a business that they have to learn—but one on which they have been largely engaged.

Apart from any operation on the coinage of India and on the exchanges, it is to be expected that a much more important influence will be effected on

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local prices of wages and commodities. Looking at these from an English point of view, it has been too much the custom to consider them as dependent on English conditions. There is, however, very little contact between what may be called the English system of prices and the Indian system of prices.

The contact is effected by the export from India to England of sugar, coffee, rice, cotton, jute, &c., the prices of which for export are determined by the London or European market prices. This, however, exercises very little influence on the main bulk of the agricultural crops of India.

Far different are the relations between England and the countries on the adjoining seas. Ireland to the west and the shores to the east and south. Every pound of meat, every fowl, every egg, each pound of butter, and all fresh vegetables or fresh fruits are liable to be taken up for the great markets of London and Paris, the prices of which, with the cost of transport, govern those of the outlying districts. Hence the general complaints of the growing dearness of living in the large and small towns, and which lends not to a levelling of prices in the proper sense, but to an augmentation of price to the higher standard.

Within each region, the completeness of railway transit contributes to such results, and the seas are bridged by steam transport, also penetrating the rivers, the prices of food effect the prices of labour to a considerable extent, and modify the operation of other causes. The Irish labourer, who, half a century ago received 4d to 6d per day, or Indian wages, now received 2s or more.

In India, as has been pointed out by me, in common with others, similar results have, of late years, been seen in operation, but they have not reached their full development, and must, therefore, continue until it has been attained. This is the point to which the attention of economists must be turned, because the quicker or slower rate of this development means the earlier or later attainments of an advanced condition by the population of Indies, and the consequent rate of public revenue.

So long as the great disparity of rate of prices between India and England exists, there must be a disturbance of all economical relations. There must be a really abnormal relation of imports and exports, an abnormal disproportion between the amount remitted to England and the rest of the revenue of India, a false relation between the supply of capital to India and its returns.

Taking this last head alone, India labours under great disadvantages as compared with many other countries. If a railway be made, say in the United States with English capital, then the returns can be calculated upon at something like English prices. In India this is not so; the railway iron and machinery shipped from England is of the same indentical cost, but the carriage of commodities and of passengers has to be undertaken on a scale wholly different. No question arises elsewhere, for instance as to the carriage of passengers at 2 pice per mile. In some countries it is impossible to charge an anna or two as here at home.

That, in many classes of enterprise, where the amount of traffic, or transport, or commodities dealt with in India would, at what may be called normal rates produce a good return, in India they give an insufficient money yield, the undertaking becomes impossible with profit, or without a guarantee burdensome to the Government, and the abundant capital of the European markets is not applied to India, while it is freely available for alien countries, which have no claim on English sympathies, in Brazil or in Chili.

It is the rise of prices now going on in India, and already referred to, which will act independently and concurrently affect the situation, dominate the commercial and financial conditions. It is, therefore, perfectly futile to talk of the application of great economical lands, when we neglect the circumstances on which their operation depends.

The development of gold working means the development of English

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knowledge and enterprise, and the consequent progress of India. Then the railway system will no longer be stinted, and corresponding benefits will be obtained. Many a commodity will rate locally at a higher price in consequence of higher wages, but the efficiency of railway transport, as compared with the bullock carts, will place the commodity at the port, under commercial conditions. Many commodities, which now cannot be moved and are expended from trade, will under quick transport, become exchangeable articles of commerce. If these results were only to be regarded as possible or probable, the whole subject of the gold fields would be worthy of the gravest consideration, and as one not to be dismissed on doubts, or on the absence as yet of ascertained realisation.

GOLD IN CEYLON.

Our attention has been called to the references made by Sir Samuel Baker in his "Eight Years in Ceylon" to the "Prospecting for Gold" in this Colony which occupied public attention in 1854. He puts the matter very plainly before his readers, and certainly does not spare Sir George Anderson's government:—

In Ceylon, where the chief article of production is coffee, land (upon an estate) which is not suitable to this cultivation is usually considered waste. Thus the Government and the private proprietor are alike losers, in possessing an amount of unprofitable soil.

Now, surely it is the commonsense object in the establishment of a botanical garden, to discover for each description of soil a remunerating crop, so that an estate should be cultivated to its uttermost, and the word 'waste' be unknown upon the property.

Under the present system of management this is impossible; the sum allowed per annum is but just sufficient to keep the gardens in proper condition, and the abilities of the botanist in charge are sacrificed. Many a valuable plant now lies screened in the shades of remote jungles which the enterprising botanist would bring to light, were he enabled by Government to make periodical journeys through the interior. These journeys should form a part of his duties; his botanical specimens should be his game, and they should be pursued with the ardour of the chase itself, and subsequently transferred to the gardens, and their real merits discovered by experiments.

But what can be expected from an apathetic system of Government? Dyes, fibres, gums may abound in the forests, metals and even gold may be concealed beneath our feet; but the Governor does not consider it apart of his duty to prosecute the search, or even to render facilities to those of a more industrious temperament. What can better exemplify the case than the recent discovery of gold at Nuwara Eliya?

Here was the plain fact, that gold was found in small specks, not in one spot, but, *everywhere* throughout the swamps for miles in the vicinity. At a depth of two or three feet from the surface, this proof was adduced of its presence; but the Governor positively refused to assist the discoverers, ('diggers,' who were poor sailors visiting Ceylon), although they merely asked for subsistence until they should be able to reach a greater depth. This may appear too absurd to be correct, but it is nevertheless true.

At the time that I commenced these sketches of Ceylon, the gold was just discovered, and I touched but lightly upon it, in the expectation that a few months of labour, aided by Government support, would have established its presence in remunerating quantities. The swampy nature of the soil rendered the digging impossible, without the aid of powerful pumps to reduce the water which filled the shaft so rapidly, that no greater depth could be obtained than 18 feet.

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The diggers were absolutely penniless, and but for assistance received from private parties they must have starved. The rainy season was at its height and torrents fell night and day with little intermission. Still these poor fellows worked early and late, wet and dry, ever sanguine of success, and they at length petitioned the Government to give them the means of subsistence for a few months—'subsistence' for two men, and the assistance of a few coolies. This was refused, and the reply stated that the Government intended to leave the search for gold 'to private enterprise.' No reward was offered for its discovery as in other colonies, but the Governor would leave it to 'private enterprise.' A promising enterprise truly, when every landholder in Ceylon, on referring to his title-deeds, observes the *reservation of all precious metals to the crown.* This is a fair sample of the narrow-minded, selfish policy of a Government which in endeavouring to save a little, loses all; a miserable tampering with the public, in attempting to make a cat's paw of private enterprise.

How has this ended? The diggers left the island in disgust. If the gold is there in quantity, there it remains to the present time, unsought for. The subject of gold is so generally interesting, and in this case of such importance to the colony, that, believing as I do that it does exist in large quantities, I must claim the reader's patience in going into this subject rather fully.

Let us take the matter as it stands.

I mentioned at an early part of these pages, that gold was first discovered in Ceylon by the diggers in the bed of a stream near Kandy; that they subsequently came to Nuwara Eliya, and there discovered gold likewise.

It must be remembered that the main features of the country at Nuwara Eliya and the vicinity are broad flats or swampy plains, surrounded by hills and mountains; the former covered with rank grass and intersected by small streams, the latter covered with dense forest. The soil abounds with rocks of gneiss and quartz; some of the latter rose colour, some pure white. The gold has hitherto been found in the plains only. These plains extend over some thirty miles of country, divided into numerous patches by intervening jungles.

The surface soil is of a peaty nature, perfectly black, soapy when wet, and as light as soot when dry, worthless of cultivation. This top soil is about eighteen inches thick and appears to have been the remains of vegetable matter washed down from the surrounding hills and forests. This swampy black soil rests upon a thin stratum of brownish clay, not more than a few inches thick, which forming a second layer, rests in its turn upon a snow-white rounded quartz gravel intermixed with white pipeclay. This contains gold, every shovelful of earth producing, when washed, one or more specks of the precious metal. The stratum of rounded quartz is about two feet thick, and is succeeded by pipeclay, intermixed with quartz gravel, to a depth of eighteen feet. Here another stratum of quartz gravel is met with perfectly water-worn, and rounded to the size of a twelve-pound shot. In this stratum the gold was of increased size, and some pieces were discovered as large as small grains of rice; but no greater depth was attained, viz., eighteen feet from the surface. No other holes were sunk below ten feet, on account of the influx of water, but similar shafts were made in various places, and all with equal success. From the commencement of the first stratum of quartz throughout to the greatest depth attained gold was present.

Upon washing away the clay and gravel, a great number of gems of small value remained (chiefly sapphire, ruby, jacinth, and green tourmaline). These being picked out, there remained a jet black fine sand, resembling gunpowder. This was of great specific gravity, and when carefully washed, discovered gold, some in grains, some in mere specks, and some like fine golden flour.

At this interesting stage the search has been given up; although the cheering sight of gold can be obtained in nearly every pan of earth, at such trifling depths, and literally in every direction, the prospect is abandoned.

The Government leave it to private enterprise; but the enterprising public have no faith in the Government.

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Without being oversanguine, or, on the other side closing our ears with asinine stubbornness, let us take an impartial view of the facts determined, and draw rational conclusions.

It also appears that from a depth of two and a half feet from the surface to the greatest depth as yet attained, (eighteen feet), gold exists throughout.

It appears that this is not only the case in one particular spot, but all over this part of the country and that this fact is undeniable; and, nevertheless, the Government did not believe in the *existence* of gold in Ceylon until these diggers discovered it; and when discovered, they gave the diggers neither reward nor encouragement, but they actually met the discovery by a *prohibition* against the search; they then latterly withdrew the prohibition and left it to private enterprise, but neglected the unfortunate diggers. In this manner is the colony mismanaged, in this manner is all public spirit damped, all private enterprise checked, and all men who have anything to venture disgusted.

The liberality of a Government must be boundless where the actual subsistence for a few months is refused to the discoverers of gold in a country where, hitherto, its presence had been denied.

It would be speculative to anticipate the vast change that an extended discovery would effect in such a colony as Ceylon. We have before us the two pictures of California and Australia, which have been changed as though by the magician's wand within the last few years. It becomes us now simply to consider the probability of the gold being in such quantities in Ceylon as to effect such changes. We have at present these simple data,—that in a soft swampy soil gold has been found close to the surface in small specks, gradually increasing in size and quantity as a greater depth has been attained.

From the fact that gold will naturally lie deep, from its specific gravity, it is astonishing that any vestige of such a metal should be discovered in such spongy soil so close to the surface. Still more astonishing that it should be so generally disseminated throughout the locality. This would naturally be accepted as a proof that the earth is rich in gold. But the question will then arise—Where is the gold? The quantities found are a mere nothing, it is only dust: we want 'nuggets.'

The latter is positively the expression that I myself frequently heard in Ceylon,—'We want nuggets.'

Who does not want nuggets? But people speak of 'nuggets' as they would of pebbles, forgetting that the very principle which keeps the light dust at the surface, has forced the heavier gold to a greater depth, and that, far from complaining of the lack of nuggets when digging has hardly commenced, they should gaze with wonder at the bare existence of the gold in its present form and situation.

The diggings at Ballarat are from 100 to 160 feet deep in hard ground, and yet people in Ceylon expect to find heavy gold in mere mud, close to the surface. The idea is preposterous, and I conceive it only reasonable to infer from the present appearances, that gold does exist in large quantities in Ceylon. But as it is reasonable to suppose such to be the case, so it is unreasonable to suppose that private individuals will invest capital in so uncertain a speculation as mining, without facilities from the Government, and in the very face of the clause in their own title-deeds 'that all precious metals belong to the crown.'

This is the anomalous position of the gold in Ceylon under the governorship of Sir G. Anderson.

Nevertheless it becomes a question whether we should blame the man or the system; but the question arises in this case, as with everything else in which Government is concerned, 'Where is the fault?' echo answers, "Where?" But the public are not satisfied with echoes, and in this matter of fact aged people look to those who fill ostensible posts and draw *bona fide* salaries; and if these men hold the appointments, no matter under what system, they become the deserved objects of either praise or censure.

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Thus it may appear too much to say that Sir G. Anderson is liable for the mismanagement of the colony *in toto*—for the total neglect of the public roads. It may appear too much to say, when you came to the colony you found the roads in good order: they are now impassable; communication is actually cut off from places of importance. This is your fault, these are the fruits of your imbecility; your answer to our petitions for repairs was, 'There is no money;' and yet at the close of the year you proclaimed and boasted of a saving of 27,000*l.* in the treasury! This seems a fearful contradiction; and the whole public received it as such. The governor may complain that the public expect too much; the public may complain that the governor does too little.

Upon these satisfactory terms, governors and their dependents bow each other out, the colony being a kind of opera stall, a reserved seat for the governor during the performance of five acts (as we will term his five years of office); and the fifth act, as usual in tragedies, exposes the whole plot of the preceding four, and winds up with the customary disasters.

Now the question is, how long this age of misrule will last.

We trust the present Government of Ceylon will lay this lesson to heart and act in a rather more energetic and liberal manner than did its predecessor twenty-seven years ago. Meantime, it is of some practical importance to the Colony to have so staunch a believer in its auriferous wealth as Sir Samuel Baker at headquarters. He is the special friend of His Grace the Duke of Sutherland (who, by the way, visited Kandy and Nuwara Eliya in 1875), and of other enterprizing public men in England who would speedily ensure the development of gold mines here, provided it were shewn on competent authority that a paying reef were available. From the article on "Gold" in the latest issue of the "Encyclopædia Britannica" we quote some passages of general interest at this moment:—

The association and distribution of gold may be considered under two different heads, namely, as it occurs in mineral veins and in alluvial or other superficial deposits which are derived from the waste of the former. As regards the first, it is chiefly found in quartz veins or reefs traversing slaty or crystalline rocks usually talcose or chloritic schists either alone or in association with iron, copper, magnetic and arsenical pyrites, galena, specular iron ore, and silver ores, and more rarely with sulphide of molybdenum, tungstate of calcium, bismuth, and tellurium minerals. Another more exceptional association, that with bismuth in calcite from Queensland, was described by the late Mr. Daintre. In Hungary, the Urals, and northern Peru, silicates and carbonates of manganese are not uncommonly found in the gold and silver bearing veins. In the second or alluvial class of deposits the associated minerals are chiefly those of great density and hardness, such as platinum, osmiridum, and other metals of the platinum group, tinstone, chromic, magnetic, and brown iron ores, diamond, ruby, and sapphire, zircon, topaz, garnet, &c., which represent the more durable original constituents of the rocks whose disintegration has furnished the detritus. Native lead and zinc have also been reported among such minerals, but their authenticity is somewhat doubtful. * * * *

In vein mining, which is more difficult and costly, a larger yield is necessary, but probably 5 dwt., or about £1 in value per ton, will in most places represent paying quantities from quartz containing free gold, *i. e.*, not associated with pyrites. The proportional yield and quantities of the different kinds of auriferous materials treated in the colony of Victoria during the last three months of 1878 were :—

	Tons.	Yield per ton. oz.	dwt.	gr.
Alluvial sand "washdirt"	173·379	1	1	59·6
Cement (gravel) requiring crushing	5871	0	4	21·4
Quartz	222·775	0	9	21
Quartz tailings	11·139	0	1	18
Pyrites and blanketing (or collected on blanket tables)	1·599	2	6	13·7

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In the less tractable minerals, such as arsenical pyrites occurring in the lower portions of the veins, as much as one-and-half to three ounces may be required for profitable working. When associated with the ores of other metals, such as silver, lead and copper, the extraction of the gold is in most cases an incidental and final operation in their metallurgical treatment, and may, therefore, be best considered in the articles on these metals.

GOLD IN CEYLON.

We now proceed to reprint all that appeared on the subject of "Gold in Ceylon" and connected topics, in the *Observer* of 1854:—

(From the *Colombo Observer*, March 2, 1854.)

To crown all, there are rumours afloat that some experienced Australian diggers have been prospecting not far from Colombo and have discovered a regular "Table" of Gold. We receive this rumour with great caution. Gold distributed in dust or flakes exists in Ceylon as it does wherever there is quartz: but, well peopled as this country has been for ages, and thoroughly searched for precious stones, we scarcely think that nuggets or masses of gold could have escaped discovery. Nothing is impossible however, and deep digging may reveal what surface explorers, practical and scientific, have sought for in vain.

(From the *Colombo Observer*, March 9, 1854.)

We are bound to state that all the information we have received since our last tends towards the probability of a discovery of gold, although it will be well to reserve implicit credence to the statements made until the report of the Superintendent of Police, who is proceeding to the spot has been obtained. It appears that some of the men engaged in navigating the ship "Faithful" had been diggers in Australia. On their arrival here, six of them asked Capt. Manning for a few days' leave to go "prospecting," under the firm conviction, looking at the features of the country, that Gold existed. The leave was granted, and it would appear that the men journeyed along the Kandy road to the 32nd mile stone, then striking away to the left. It would seem that this brought them to the bed of the Maha Oya on the borders of the Hapitigam Korale, just within the boundary of the Western Province, where it joins the district of Kurunegala. Here they commenced at once to wash the quartzy sand by the aid of a simple wicker appliance known amongst the diggers as a "Tom." The immediate result, according to two of the men who returned to Colombo to report was, that Gold dust was found in quantity not only to repay the labour of washing, but to justify the assertion that the discovery would make Ceylon a rich country. The Gold dust was brought to Colombo, and the result of various tests to which it was subjected at the Medical Store is a decision that it is pure gold. The remaining question then of course was, "Did this gold come originally from Australia and were the sailors hoaxing." The only means as yet available to set this question at rest has been a close examination of the two men who returned and we are informed that the result of such an examination has been very much in their favour. They gave the fullest and most candid account of all their proceedings and, appeared quite pleased at the idea of the Superintendent of Police accompanying them to where they had left their four companions at work. In a few days, therefore, Mr. MacCartney's report to Government will set this important question at rest, deciding that Ceylon is to "hasten slowly" in her career of coffee and coconut planting, or setting our friends, the planters, quaking in their shoes at the prospect of the great though temporary dislocation of all existing relations of labour, capital and enterprise which must ensue as the precursors of the period when Ceylon shall rapidly rise to the dignity of a nation teeming with a wealthy people and traversed in every direction by Roads and Railways and Electric Telegraphs. Great revolutions are occurring in the earth, and why should not the ancient

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Taprobane awake from the slumber of ages, proving that if she is not the Ophir of Solomon, she is yet the land of Gold! We believe the earth is yet young:

We are the ancients of the earth
And in the morning of the times.

(From the *Colombo Observer* March 11, 1854.)

But probably the most striking item of intelligence from Ceylon on this occasion is that which announces the alleged discovery of Gold by some Sailor Diggers from Australia. It is greatly to be regretted that the present Mail should leave Ceylon with the question in an uncertain state. The Superintendent of Police proceeded to the scene of the alleged discovery, about 30 miles from Colombo, on the evening of the 9th, and his report is anxiously expected. Our readers will not err, we think, in exercising a considerable degree of scepticism as to gold being found here in sufficient quantities to render working for it so remunerative as to interfere with other and established industrial pursuits. We wait for information, however, and say boldly "Who's afraid." In our columns will be found the best accounts we could get hold of, but as usual in such cases there are errors of detail. Capt. Manning of the "Faithful" corrects some which affect him, in the following letter:—

Barque "Faithful," Colombo Roads, March 11th, 1884.

SIRS,—Having seen a paragraph in your *Journal* of the 9th instant, entitled "Gold in Ceylon," I beg to contradict that part of it which relates to my ship and self. The paragraph I allude to, runs thus:—"It appears that some of the men engaged in navigating the ship "Faithful" had been "Diggers" in Australia, on their arrival in this Port six of them asked Capt. Manning for a few days leave to go "Prospecting" under ihe firm conviction looking at the features of the country that Gold existed. The leave was granted, &c., &c."

Now sir, on my arrival at this port I took all these "Runners" before the Collector of H. M. Customs and formally discharged them. Some few days after seven of them returned to the ship and wished to sail in her again; after being on board two days and not on the ship's Articles, some intelligence appears to have reached them from the shore, for on the third day four of them made various excuses that they wished to leave the ship, one said I want to get back to "Australia," a second I want to see a doctor, the other two said 'two of us is not enough to tar the rigging down and we will thank you to let us leave the ship."

I, having no claim on the men, had no alternative but to let them go. No mention whatever was made of gold to me and it was several days after that I heard a rumour about the Gold. All I hope is they may *not* find the old proverb come true that "it is not all gold that glitters."

I remain yours truly,
JOHN MANNING.
Master, Bk. "Faithful."

(From the *Colombo Observer*, March 12, 1854.)

In our last ordinary issue we announced the all-but certainty of Gold in Ceylon; and have now the pleasure to state that doubt is entirely removed by the arrival of the joint report (then expected) of Mr. MacCartney the Superintendent of Police, and Mr. T. Power, Assistant Government Agent, which says that they witnessed the digging and washing of "*two pans of Earth*" which contained "*very many minute particles of Gold.*"

Their report is dated "Yattegodde, 11th March (yesterday) and is unavoidably hurried in order to reach Colombo in time to be forwarded by Government to the Secretary of State by the out-going Overland Mail.

We may add that the Mudaliyar (Native Headman) of the District sent in yesterday to the Government Agent of Colombo a specimen of the Gold

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which he also saw dug by the sailors; and that Mr. Layard will leave for the spot this evening.

The locality is about 40 miles from Colombo—near Girooele on the road from Negombo to Kurunegala. A good carriage road runs all the way from Colombo to the scene of action.

We have as yet no precise information about the proportionate quantity of Gold which the earth contains; but it cannot be insignificant, seeing that the sailors have made the discovery, and are old Californian and Australian diggers, continue at the work.

The next report we hope will be the result of *personal* inspection.

The Discovery of Gold in Ceylon.

The above was got up yesterday with special reference to the Express which left at ½ past 5 to overtake the Overland Mail. Copies were despatched to all the leading London Newspapers, to subscribers to the overland Observer, whose papers are posted from our Office, and to our subscribers generally. The question as to the substance found being Gold seems entirely set at rest, all the Government Officers concerned expressing no doubt of this fact, and all the chemical tests applied to the specimens received giving the same result and determining the Metal to be Gold. The remaining question—and one which we hope soon to see settled by the report of our special Commissioner who left for the Diggings last night—is the percentage of auriferous matter in the quartzy sand. No nuggets, we believe, have as yet been found, although they may be discovered farther *down* in the earth, or farther *up* towards the source of the Maha Oya in the mountains of the interior. If Gold *dust* only continues to be found, the question of the pursuit becoming highly remunerative will remain still doubtful. Many of our friends, we suspect, will fervently pray that this latter may be the eventual result. A contrary one would doubtless lead to much temporary embarrassment and distress, but it would be ultimately "the making" of Ceylon and its people. Nothing like gold for "developing the dormant resources" of a country and the dormant energies of individuals. While we are writing, a respectable Burgher steps into our office, and begs us to suggest to the unemployed young men of his class, that while Europeans are posting away to see for themselves, *they*, so much more closely bound to the soil, ought not to be behind. Bands of them can club together and support each other in dignifying the mamotie and the cradle to an elevation as great as that occupied by the pen of the copyist. Should gold digging really become a permanent and profitable pursuit, we have little doubt that after a time it will assume what appears to be the normal condition of enterprise in India—Asiatic labour supported by European capital and guided by European oversight. The Tamil coolies from Southern India will pour in in multitudes. But in this and in other things they will act much like children. They will look to Europeans for regular arrangements to procure shelter and supplies, they in return working for day wages or a definite share in the proceeds. And then as in Australia, many will become disgusted at want of success—they will prefer the steady and certain receipt of the Planters' rupees, and by and by there will be a superabundance of labour to cultivate and gather coffee. No fear that intelligent, enterprising and foreseeing Anglo-Saxons with some capital at their command will allow themselves or their investments to go to the wall. But other classes besides intelligent Europeans and docile natives will come upon the scene. Face to face with the timid Asiatic will be brought the rough sons of labour of Europe and America—not the steady and the good, but the reckless pioneers in all that is adventurous and wild drunken, swearing, fighting sailors who will desert the shipping, and diggers from California and Australia with Bowie knives and life preserves (?), and Colt's revolvers. How these discordant elements can work together without coming into disastrous or fatal collision will form a problem requiring the most prompt and sagacious action on the part of Government.

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Girooella or Girioulle is a village on the left bank of the Maha Oya on the road from Colombo to Kurunegala via Negombo. We lately travelled over this road as far as Dalpatugedara (within 7 miles of Girooella) and can answer for its being in beautiful order so far. Girooella is about half way between Negombo and Kurunegala, being 22 miles from the former and 25 from the latter. The Hapitigam Korale of the Western Province which borders on the Maha Oya at the place contains a population of 12 to 14,000 inhabitants. In proceeding from Colombo to Girooella the traveller crosses the Kelani Ganga over a Bridge of Boats at the 3rd mile stone, and a little beyond the 9th mile finds the Resthouse of Jaela. Negombo is 10 miles further on, but the road to be pursued turns away to the right just before reaching the town. To Kandawelle at the end of the base line through Kadirane gardens is 3½ miles from Negombo. Katookandy, with a number of Sugar and Coconut estates, and where Mr. Nietner is trying Nutmegs and Cloves, is 8½ miles further on. Dalpatugedara village, where the last of the European properties, that of Lt. Margesson is situated, is 3 miles further on. Then at a distance of 2 miles more is Welliheina or Cottadeniawa, and 5½ beyond the road terminates at the ferry and village of Girooella, where the traveller crosses the Maha Oya, a river, the natives *now* say, so impregnated with gold, that the very waters taste of it! And this raises some interesting antiquarian questions. It appears from some of the ancient Sinhalese records that many of the villages were distinguished as "gold yielding," and that at one time, at least 16 gold mines were known in Ceylon. Query, whether geographers may not have to reconsider the decision which has lately and after much controversy fixed on a portion of the African Coast as the Ophir or Paravaim of the Scriptures, whence Solomon received his gold and apes and peacocks. Ceylon, with its great emporium at Mannar, may again become the favourite. The Phœnicians are said to have traded in this gold of Ophir long before the time of Solomon and even of Job by whom it is mentioned. And many an old history speaks of expeditions to and

Embassies from regions far remote,
From India and the Golden Chersonese,
And utmost Indian isle Taprobane.

We observe that the local *Times* in a small Extra issued this morning continues to express himself sceptical as to the substance received being actually gold, but on this head there remains no doubt. Our contemporary states that a quantity is under analyses by Dr. Ellery of Kandy. Dr. Ellery's report has reached Colombo, and we learn that it entirely agrees with that of Mr. Anthonisz here. It is gold ore in connection with a supplement of iron and small nodules of other substances. It is curious enough that Dr. Davy in his work in Ceylon should have recorded the statements that both Gold and Quicksilver had been found native in Ceylon only to throw doubt on them. Able and keen as Dr. Davy was as an observer, however, it must be remembered that the period of his residence and the extent of his researches were limited. We have received the following notes on the subject of the discovery:—

Colombo, 13th March, 1854.

Dear Sirs,—Our planting friends are, I believe, much alarmed, lest the discovery of Gold should cause a scarcity of labour for estate purposes, but I fancy their fears are for the present groundless, if it be true that Government, at the instance of the Great Obstructive, has sent a detachment of Rifles to prevent anything being done till the position of each digger's hole can be ascertained with trignometrical exactness; in this case we look for the commencement of the diggings in the reign of Albert the Third, and our friends in the interior may keep their minds at ease and depend on gathering their next crop without loss, even should it amount to 600,000 cwt.—Yours truly, Y. Y. Z.

Kandy, 12th March.

I do not know if you have got any official information about the *Gold*, but I have just heard that the Governor received intelligence last evening from

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Mr. T. C. Power who had been sent to enquire into the matter, that there was no mistake about it, and gold there was; and it now only remained to be ascertained as to the extent of the gold fields.

The natives here have got hold of the report, and I expect a few days will see Kandy thinned. A pretty "mess" for a time we shall all be in.

LATEST GOLD NEWS.

We have just seen the joint report of Messrs. MacCartney and Power dated yesterday from Yattelgodde.

To satisfy themselves they selected a fresh spot, dug the earth, washed it, and found gold.

The diggers then continued their operations, and out of three pans of earth washed a quantity of gold which Mr. Power was to carry to Kandy for the Governor's inspection.

The small quantity of gold hitherto found is fairly attributed by the diggers to the imperfection of their machinery. This was to be immediately remedied when the value of the discovery would be decided.

We learn from another source that so confident is the leading digger of success, that when he gets the requisite machinery, he says he can afford to pay parties employed by him £2 per day wages! He says he is confident there is a much richer spot close to Ambepussa, which he passed on his way to the present locality.

Mr. Caldwell, who accompanied Mr. MacCartney from Colombo, has drawn a map of the surrounding country from which it appears that the spot where the diggers are at work is just within the Seven Korales District, it being about 50 yards from the Maha Oya where it bounds the Western Province. The locality it appears is within a few miles of Ambepusse.

Hundreds of persons were flocking to the spot, so that it was deemed necessary to leave a small party of Police to preserve order.

In the ancient manuscript to which we have alluded elsewhere, gold is specially mentioned as found in *Belligalle Korle*.

(From the *Colombo Observer*, March 16, 1854.)

THE "EXAMINER'S" GOLD INTELLIGENCE.

The *Examiner* issued an Extra last evening purporting to give the result of the personal researches of one of the Editors, but all the real information afforded bears a marvellous resemblance to the two grains of wheat in a bushel of chaff, or the needle in the bottle of hay. Considering also that the writer is no longer a disinterested party, having invested in the purchase of land for building purposes, his statements, where they lean to the sanguine, must be received *cum grano*. It is certainly very important to know that the diggings are called "Bradley's diggings." That is a fact. But we announced in our regular issue that the locality was close to Ambepusse, and actually within the limits of the Kurunegalla district. Why Mr. Layard should be blamed for sending his Mudaliyar to ascertain what personal observation alone could settle, perhaps the writer can explain. The horror indicated at the sin of Sunday travelling is amusing enough, considering the quarter whence it comes. We suppose no portion of that day was occupied by our friend in prospecting or in concluding his bargain with the natives for their lands. Why the diggers should have been angry at the charge of having asked and obtained leave to go prospecting, we cannot well see, but we can easily imagine the more intelligent and reasoning Editor of the *Examiner* mollifying the diggers and telling them candidly that there was nothing to be angry at. That would be the part of a generous man and a gentleman under the circumstances, and of course "Brutus is an honorable man." The public will be glad, however, to learn, that the six diggers had regular discharges from their Captains: three from Capt. Manning of the "Faithful," and three from Capt. Ross of the "Martin Luther." We are thankful to learn that a "Tom" is not "*a wicker appliance*," as in our

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ignorance we described it, but a sort of wooden box with a perforated iron bottom at the lower end. Besides this "Tom," tin pans are used to bale and fill with. We are told further that "the diggers are making a dam across the river and a hose 80 yards long, and when they have thus obtained a consonant and regular supply of water, which we [Ed. *Ex.*] expect will be by Thursday next—about 12 times the quantity of earth can be worked. Among the soil were found several small rubies, and we took out a piece of Ceylonite.

"We may mention that a native headman a short time ago found some nuggets, one of which he sold to Mr. Jayetilleke Mudaliyar of Kurunegalle (who told us the story), which was so soft as to require 9 worth of silver to be added to enable the jeweller to work it. He has been sent for. The place where he found it, is stated to be about 5 or 6 miles from that of the present operations.

"P. S.—The best and shortest road is from Colombo to Ambepusse rest-house, 36 miles of admirable road; from thence to "Bradley's diggings" there is a good bridle path 3¼ miles; at Ambepusse resthouse, every needful supply can be obtained."

The above is the sum of the personal observations of our *Examiner* friend. We must be thankful for what we can get; but really we should have wished something more definite as to the nature of the formation in which the gold is found, the percentage yielded by a certain quantity of earth, the time occupied in digging and washing, &c.

All this we hope to have in good time.

The Gold Intelligence of the "Times."

Our friend of the *Times* has articles on the Gold Diggings embodying information supplied, evidently, by the Superintendent of Police and the gentleman who accompanied him from Colombo. These accounts agree with all that we have reported—Gold there undoubtedly is and close to the surface, but weather in sufficient quantities to render digging remunerative remains to be proved. That is the practical and commonsense view of the case, but the *Times* Editor finishes off in his own peculiar style and in a manner anything but flattering to his informants. His "P. S." is,

"We have since heard that the diggings are likely to be a failure—or, in other words, all bosh!"

It is quite possible that a failure, economically viewed, may be the result, but until prospecting up towards the mountain sources, and deep diggings and thorough washings have been tried, no one can confidently so decide. It is the part of wisdom, doubtless, not to be over-sanguine or over-fearful (as the case may be) of a large and valuable discovery of gold; but it is surely also prudent to reserve final opinions until they can be founded on repeated experiments and full information. Our own course will be to collect for our readers all possible information wherever we can find it. The result of personal observation is embodied elsewhere—we have afforded the infinitesimal intelligence contained in the *Examiner* Extra, and we now proceed to glean what we find of interest in the *Times*. We quote from our contemporary as follows:—

"The following are, we believe, the results of the observations of parties who have proceeded to the spot.

"You go as far as Ambepusse at the 37th milestone on the Kandy road, and then strike off to the spot round the back of a high well-known hill close to the resthouse, and follow a bridle path through a jungle for about 3¼ miles, which brings you to the bank of the Maha Oya, at a place called Girioella or Girrawella, at which place Bradley (the gold discoverer) and his two friends are living in a bough hut, constructed of the jungle bushes of the place, where they were found busily engaged in making a "Tom," a machine about the length of a common couch constructed of planks with several compartments of spaces, one next to the other, but each space a little lower than the other, similar to a stair-case. At the bottom is a flat iron plate pierced

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full of holes, which allows the smaller portions of the washings to fall into a reservoir together with the gold: we may remark that all the "stuff" is first pounded and beaten as much as possible to small fragments to separate any portion of gold which may be amongst its interstices. The residue is a fine black sand, in which the gold is seen in small spangles. This sand on being dried is gently blown away and the gold left, the value of the sand being according to Bradley worth four shillings an ounce in the state, it is in before the useless particles are blown off. The new diggers were also preparing a dam accross the river to raise the water to a level with the top of their "Tom" which was to be supported two or three feet above the ground. They were also constructing a hose of tarred canvass of about 100 feet long, to bring the water to the "Tom," the object being to obtain a continuous and gentle stream of water pouring on the mass of "stuff" supplied to the "Tom." We hear that Bradley was complaining bitterly of the extortions of the natives already, his coolies asking a rupee a day—fowls were at 1s. 6d.—whilst for a few bits of plank to make his "Tom," he had to pay 15 shillings—the beginning of the end, if gold is actually to be found in Ceylon.

"We are told that in the vicinity of the place where Bradley and his friends are, the natives exhibit the utmost apathy, looking on without the slightest interest in their proceedings beyond what they can make out of them. They are now well supplied with provisions including wines, hams, flour, beef, *etc.* and appear determined to enjoy the real life of a digger. Bradley says he has lost three fortunes already, and is so perfectly persuaded of the richness of the locality that he can afford to pay £2 a day for a cooly to dig for him, and with the profits set up a "Public" and make a rapid fortune. Allowing for a few little eccentricities inherent to a sailor, they all appear intelligent men, and appear to be fully aware of what they are about. We however suspect the first thunderstorm in the hills will rather astonish them, when they see the short work a fresh in the Maha Oya, will make of the dam they have constructed.

"As Bradley and his companions are for the nonce public characters, we must tell one or two anecdotes which are quite refreshing:

"One of the Mudaliyars gave the party a dinner over the river, and on their return the next day, the other Mudaliyar asked Bradley what time got home. 'Got home!' said he, 'why really I don't know—for I left my watch on the piano.'

"On their way over on a raft, the whole of them got upset in the stream, but 'happy go lucky' they would insist on dining in their wet clothes. On their return they took to the water again, but being unable to find the opposite shore, they returned to the bank and lay down to sleep, wet as they were in the sand. It is easy to see if they indulge in such pranks as those that a month must end their career in such a climate as the one they are located in, where independently of the notorious unhealthiness of the place, the heat is described as being almost unbearable. We understand that a day or two ago some six or seven other seamen of ships in the roadstead left Colombo for the new diggings, and some three or four have followed today."

One idea which occurs to us on reading the above is, that with an excellent road to Ambepussa and a coach daily passing down, it may ultimately be found preferable to perform the rough washing at the diggings; and to send the gold-impregnated sand here, for the more perfect separation of the ore by chemical appliances. The notice of the apathy of the natives in the face of gold digging operations must be received *cum grano*. It would be difficult for the natives to please the *Times* Editor. If they look on, they are apathetic; if they charge the market-price for their fowls, they are extortionate; and if they rushed to dig, we have no doubt they would get abused for their cupidity. Government, however, has taken care that the natives shall be deprived of all encouragement, at least, to dig for the enrichment of themselves or the country. From another account in the *Times* we quote as follows:—

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"The original discoverer, William Bradley, more commonly known among his comrades by the gentler name of 'Bil,' is according to his own account, a native of Middlesex; and, has spent many years in the gold-fields of California and Australia, by turns 'prospecting,' and taking part in the still more lucrative pursuits, which invariably follow in the wake of the diggers. From Australia he shipped in the 'Martin Luther' for this port, and, not as the *Observer* has it, took a few days' leave, but obtained his regular discharge, owing to a difference with the captain on account of a proposal to reduce his pay from £12 to £4 per mensem for the remainder of the voyage. Two or three from his own ship followed his example, and being struck with the similarity of this country to the gold districts of Australia and California, they turned into the fields off the Kandy road, when under Bill's guidance, with their clasp knives and a tin basin, they found a few specks of Gold.

"Inspirited by their success so far, they returned to Colombo for supplies, and being soon after joined by four others, who, in like manner, obtained their discharges from the 'Faithful,' they started on a second expedition. By the direction of the school-master at Weweldeniya, when enquiring about the large rivers of the place, they struck upon the Maha-Oya, and following its course upwards for a considerable distance (with the exception of one who turned back), they at length halted at a spot about four miles from Ambepusse, on the further bank of the stream."

THE "OBSERVER'S" GOLD INTELLIGENCE.

A personal inspection of the so-called "Diggings" has added but little to the previously established fact as to the existence of gold. It may, and probably will be found in sufficient quantity to pay when operations have fairly commenced; but as yet nothing of the sort has been accomplished. The seven sailors, who are a happy, well-conducted set of men, and are taking things easy, have raised and washed about 300 or 400 cubic feet of gravel and stones, from which they say they obtained about an ounce at least (judging by guess) of gold, which they have given away to different persons—principally for Government. On Monday morning we witnessed the washing of 16 buckets of gravel, done at the request of the Government Agent of the Western Province, and which produced half a grain weight of gold; and on Tuesday morning 12 baskets washed for ourselves yielded about the same quantity, but containing the largest specimen that has yet been seen—about the size of the half of a small pin's head flattened. We have also this morning seen an unmistakeable flake of gold washed from a single basin of gravel taken from the bed of the river. Whilst we were at the spot, the men were engaged in sewing a hose some 150 yards long, for the purpose of conveying water from a temporary dam which the natives, at the desire of the Government Agent, were assisting them to construct. When these should be completed, as was expected about Tuesday evening or Wednesday morning, the men intended to set to work in earnest, and entertained the most sanguine expectations of success. They said they considered the appearances more promising than in either California or Australia, for though they might not find large nuggets here, the "colour of the gold" or minute particles were so generally diffused, that experience taught them it was the most profitable soil to work in. In those countries a man, they said, might dig for weeks without "getting the colour," but here it was always present, and would therefore give a constant yield. They had been 7 or 8 days "prospecting" before they selected the spot, but had found "the colour" in several other places, especially in the same river, both higher up and lower down.

The locality is situated just within the first gneiss ranges of the hilly country. The spot they have selected is in a sudden bend of the river, where the eddy of floods has thrown up a quantity of small gneiss boulders, with rounded quartz, stones, and a quantity of quartz gravel. The bed of the river is over gneiss—the hardest part remaining, but smoothed—the softer being worn out into deep chinks. The stones and gravel lying upon this they wash—especially the sand lying upon the "bed rock," and in the chinks or "pockets" which have to be

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scraped out carefully with a "pick-axe" or knife, as being likely to contain the most gold. The deposit of the metal in these localities, and the effects of washing for it, depend upon the great specific gravity or weight of gold. From the agitation of the water in rivers, it sinks to the lowest point—through quartz gravel, etc., and lies upon the bed-rock; and when the gravel is agitated in the "Tom" and the receiving trough below, the gold in like manner finds its way to the bottom. So also when the residuum sand is taken in a tin dish (or cradle elsewhere) the gold and magnetic iron ore (black sand) fall to the bottom and allow the gravel to be thrown out. The yellow mica, which co-exists in large quantities, being very light, is among the first to be washed away; whilst the black iron ore being of the greatest weight, next to the gold, remains with it to the last. Indeed, so difficult is it to separate these two by washing in a tin dish (the proper method being to mix them with quicksilver, which forms an amalgam with gold), that considerable quantities of the precious metal were manifestly lost in the experiments we witnessed.

The dam is not intended, as is generally supposed, to drain the bed of the river, but merely to gain a head of water to pass along the hose and "Tom" for the purpose of washing. The men say that this will not only save them the labour of bailing up water, but be more efficient by affording a constant and steady stream. When the rains flood the river, they intend to "prospect" the adjoining high land, their hose furnishing them with the requisite supply of water.

Notwithstanding the absurd Government Proclamation, which sensible people will snap their fingers at, we hope all intelligent persons who have time to spare, will at once proceed to the spot and take practical lessons in gold washing, and then return to their several places and go "prospecting," for which they require only a tin dish and a mamotie. To aid young men in their search, we shall in our next give the most recent information regarding gold finding in other countries. In the meantime we may explain that the diggings may be best reached by parties from Colombo going 31½ miles on the Kandy road, when a walk through the paddy-fields (now, however, dry and rideable) of about 4 miles will take them to the spot. Persons coming from Kandy had better start on the walk from Ambepusse, which is about the same distance from "Bradley's diggings." For the information of strangers we may mention that the site of the diggings is at a spot as nearly as possible equi-distant from the maritime and mountain capitals of the island—Colombo and Kandy; being within an easy distance of the splendid road formed by Sir Edward Barnes, which laid the foundation of the coffee cultivation and commercial prosperity of the island, and on which continues to run daily the first line of mail coaches started in India. Just half way on this road, close to the 36th mile-stone, and little more than 3 miles from the diggings, is the excellent resthouse of Ambepusse, where supplies of every kind can be obtained. Exposure, however, should be avoided, for this beautiful valley of Ambepussa has the reputation of being one of the deadliest spots in Ceylon. The fertility of an existing plantain garden has been attributed to the fact that a whole company of British soldiers perished here from fever. But so it used to be in most parts of the interior until the climate was understood and proper precautions observed. We append a copy of the chemical analysis of one of the first portions of stuff sent to Government:—

Dr. Ellery's Analysis.

The specimen taken for examination weighing 7½ grains, consisted of some small pieces of yellowish quartz, a black powder resembling coarse emery, and several small scales of a yellow metallic-looking substance. The application of a magnet separated about ⅓ of the black powder which consisted of magnetic iron ore. One-half of the residue was acted upon by boiling nitric acid without effect; the addition of muriatic acid dissolved the metal, yielding a golden yellow solution. This, on the addition of the subjoined tests afforded the following results:—

No. 1.—Chloride of tin, gave a copious, deep purple precipitate.

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No. 2.—Solution of sulphate of iron, a dark brown looking precipitate of metallic gold.

No. 3.—A very weak solution of tincture of opium, gave a bright yellow transparent fluid.

I am of opinion from the appearance of the specimen, and from the result of the chemical examination, that it certainly contained gold.

W. ELLERY.

Kandy, March 9th, 1854.

P.S.—The Government Agent returned to Colombo this morning, and says that the progress of the dam continues slow and is sufficiently doubtful.

THE MAHA OYA.

The *Times* Editor, writing of the river in which the gold is found, states:—"The Maha Oya is a rocky river throughout its course, and is subject to vast floods in the rainy season. We have crossed it in many places from Maturata to Allowe Ferry, and it has borne the same character throughout." This is the perpetuation of an error which is natural enough when men go by sounds without consulting maps. The same mistake was made by Cassie Chitty in his *Gazetteer.* There are probably twenty streams in Ceylon called Maha Oya (the great stream), but the river in which our brother laved his weary feet in the valley of Maturata, in order to reach Allowe Ferry would have to perform a feat unprecedented in the *natural* history of Hydraulics, viz., to cross over or under a larger stream, and to ascend and cross one of the most considerable mountain ranges of Ceylon. The Maha Oya of the Maturata or Hewahette Valley is a mere tributary of the Mahaweliganga, into which it discharges its waters after a short course, and they are thus disembogued on the very opposite side of the island to that on which is situated the embochure of the golden Maha Oya. This latter rises in the district of Dolosbage, close to the Sentry Box on Raxawa, and falls into the sea about 4 miles north of Negombo, or 26 from Colombo.

The main branch crosses the Kandy road near Utuvankande and Fort King, and tributaries cross the road near Kegalle and at Ambepussa. Close to the main source at Dolosbage is a group of coffee estates, including Allagalla, Barnagalla, Paragallahettia, Madulhena, Nartakande, Raxawa, Windsor Forest, Diahetna, Penylan, Gannetenne, &c.

Important tributaries to this river rise near Gampola and drain the valley of Kadugannawa. Amongst the estates which border those tributaries are Judge Starke's, Mount Prospect, Hunugalla Kande, Kekunagolla, Wakatenne, Gadadessa, Kottagalla, Guava Hill, Ambalava, &c.

As the river approaches the sea, we have already shewn that it passes through a group of coconut estates. It will be curious if this river should be found to connect by a golden link the two great natural products of Ceylon:—the coconut which loves the breezes of the ocean and skirts the coasts, with the coffee shrub which flourishes in the keener air of the mountain zone.

ANTI-GOLD PROCLAMATION.

The following Proclamation is, we believe, not a hoax, although it is a new proof of the small amount of wisdom with which the world is governed. In this climate we could fancy every possible inducement being held out to parties inclined to go prospecting until nuggets or quantities of gold decidedly remunerative had been found. But Government has done its little best to impede the discovery, and we greatly question whether Her Majesty will at all thank those who have resorted to so curious a mode of asserting her rights:—

NOTICE.

Whereas it has been reported to Government that a small quantity of gold has lately been found near the Maha Oya, on the borders of the Western and North-Western Provinces, and whereas it is expedient that the rights of the Crown to any such gold be asserted and protected, subject to such regulations as may be hereafter made and provided.

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Notice is hereby given to all whom it may concern, that the Superintendent of Police has received instructions not to allow any persons to dig or excavate, or to carry on any mining operations under whatsoever name or pretext, with the exception of the seven individuals already so engaged with the cognizance of Government, and of any others that may hereafter be specially licensed for that purpose.

By His Excellency's command,
C. J. MacCarthy,
Colonial Secretary.

Colonial Secretary's Office,
Colombo, 14th March 1854.

We have good reason to believe that the object of the Government in issuing this Proclamation was not to discourage enterprise, but to prevent confusion and disorder. Nevertheless, we think it ill-judged and premature. At first sight the planters may be inclined to view it as framed in their interest, but it bears another aspect. The issue of a formal and solemn Proclamation by the Government will be by the natives regarded as an "endorsation" by Government of the rumours that a really valuable discovery has been made, and may increase the prevailing exitement and the desire to quit steady employment. Government cannot possibly have meant to interfere with the search for precious stones or the operation of digging for plumbago, and yet the Proclamtion seems to prohibit both these pursuits.

Ancient and Modern Notices of Gold in Ceylon.

We alluded in our last to the mention of gold-yielding villages and gold mines in some of the old native records. Further information on this head is embodied in the following Supplement which Mr. Skeen has attached to the Ceylon Almanac:—

Gold and Pearls.

In connection with the discovery of gold in Ceylon, and the alleged existence of a Pearl Bank off Mount Lavinia, the following information may perhaps be of interest:—

Gold is found only in the native or metallic state, but is generally more or less alloyed with silver, in proportions varying from a fraction to 72 per cent. When pure, its specific gravity is 19·25.

It is found sometimes in brilliant crystallized grains, but more generally in small irregular lumps or grains in veins of quartz or calcspar. It is also obtained from beds of micaceous specular iron, in the form of spangles; in decomposing blende, and amongst iron pyrites. It is, however, far more abundant in the sand of rivers, and in the alluvial deposits of loose gravel, sand and mud, which in many regions are spread over all other strata.

In the East, Borneo, Sumatra, and many other islands of the Indian Archipelago, as well as Cochin China and Siam, are known to possess productive gold mines. Of the productiveness of the Ceylon gold washings little can as yet be stated; but it has long been known to the natives that gold was procurable; and by the kindness of L. de Soyza, Esq., Mudaliyar in the translator's department of the Colonial Secretary's Office, the subjoined extracts from two ancient Sinhalese works on the geography and products of the Island are made public.

From these works, entitled Kadayimpotta, it appears that formerly the whole Island was divided into three great Provinces, called Māyā Rata, * Pihiti Rata,† and Ruhunu Rata‡. These were sub-divided, Māyā Rata

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* Maya Rata, bounded on the north by the Deduru Oya; on the east by the Mahaweliganga and the mountains; on the south by the Kaluganga; and on the west by the sea.

† Pihiti Rata, bounded on the west, north, and east by the sea; on the south by the Mahweliganga and Deduru Oya rivers; it was also sometimes called Raja Rata, as the ancient Capitals were situated in it.

‡ Ruhunu Rata, bounded on the west and north by the Mahaweliganga and Kaluganga (or Kalutara) rivers; and on the east and south by the sea. The mountainous portion of it was called Malayaa Rata.

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into 28, Pihiti Rata into 14, and Ruhunu Rata into 14 Ratas, or smaller Provinces.

In describing the various Ratas in the Province of Māyā Rata, one writer mentions, among others—*Siduruwana*, of which he says, "This country is so called from the number of streamlets, lakes, and rivers which abound in it. There are lands in it sufficient for the maintenance of the four constituent parts of an army. There are also in it rice villages, gem villages," &c. &c. The Buddhist Temple Lankatilleka Vihare is situated in this district.

From the same author the following notices are extracted:—

Kururata (Alutkuru Korle?). A pearl bank is spoken of about 6 miles from the Coast.

Pehetigalle (Pittigal Korle?). In this division there is a mine of precious stones called *Sudeya*, also a Sea-port called Mahadampe.

Belligalle (Belligal Korle?) Gold, precious stones and pearls are found here.

Dewamerata (situated between two oyas, or rivers, in the Kurunegalle District). Silver is here found in a cave.

Mensaru and *Mahaweliganga*. Several mines of precious stones.

The second author, writing in a more summary manner, declares that there were known to exist in Ceylon, at the time he wrote "64 silver and 16 gold mines, one thousand (i. e., a very great number) of Pearl banks, and 100 mines of precious stones."

We have applied to one of the best native authorities as to the possibility of identifying the Belligal alluded to by comparison with present names and divisions, but with meagre success. Our informant states:—

"I am sorry to say that the M.S. in my possession does not give any such satisfactory information about Belligal Korale as will enable us to identify the localities alluded to.

"The only items of information contained in the work are a fanciful and absurd derivation of the word *Relligalle*, from the circumstance that gold (pearl and coral are also mentioned!) as found there, the so-called limits of the district (being four stone pillars on which are engraved the figures of a shield), and the circumstance of a village of the name of *Maldeniya* being there, in which is a Buddhist temple of the same name built by King Sirisangabo. This last fact I think will lead us to the discovery of the ancient Belligalle. *Maldeniya* is a well-known name. I know a Buddhist priest of the name of *Maldeniya*, who lost a large number of books during the last rebellion in the Kurunegalle district. I believe the village is either in the Four or Seven Korles. I have no means of ascertaining it for you now, but any Kandyan of these parts will, I believe, tell you at once.

"The copy of *Kadayim Potta* in my possession is a very imperfect one I have already discovered a palpable mistake as to the number of smaller provinces into which Pihiti and Ruhunu Ratas are divided in the information I gave to Mr. Skeen. I am endeavouring to get a more correct copy. Should I glean any more information on the subject that may be interesting, I shall communicate it to you with great pleasure; but I fear, however, any information we may get from these sources will be more *curious* than practical or useful."

Soon after receiving this note, a gentleman from Kurunegalle entered our office, and in answer to our enquiries, stated that the Village Maldeniya was in the Seven Korles and not far from Kurunegalle. The Belligal Korle, however, lies in the adjacent district of Four Korles. He promised to make further enquiry and to favour us with the result.

Subsequently our correspondent wrote as follows:—

"Belligal Korle is one of the Four Korles composing the district called Four Korles."

"I am not prepared to say whether the limits of the ancient *Belligala* accord with those of the present Belligal Korle. It is sometimes called in

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the M. S, '*Belligal Rajjaya*' or 'Kingdom of Belligala.' It is therefore probable that it was one of those small principalities into which Ceylon was divided in ancient times, and was more extensive than the modern Beligal Korale. Perhaps it included part of the Seven Korales as *Maldeniya*, (which I *believe*, situated in the Kurunegala district) is mentioned as one of its villages.

"If the information given in the *Kadayım Potta* can be relied upon, it is more likely that gold may be found in *Sidurawane*, which is said to have contained *several* gold mines—*Sidurawane* is supposed to be the modern district of *Yatınuwara* and *Udunuwara*. The temple *Lankatileka* is situated there."

On turning to Turnour's Translation of the Mahawanso, we find gold mentioned in connection with the name of the celebrated Sinhalese monarch, Dutugemunu, who flourished B. C. 158, and who planned the great Ruwanweli [*Ruwanwelle*,—Gold Plain,] Dagoba or Thupo at Anuradhapura. The people were suffering from the recent war, and compulsory labour" was a bad resort, so he took to meditation; and "the tutelar deity who guarded the canopy of dominion" and the "Dewos" took the matter in hand and supplied the materials miraculously. We are told that:—

"In a village named Acharawattigomo, situated three yojanas to the north-east of the capital, on a space of ground sixteen karissa in extent, golden sprouts of various descriptions sprung up, in height one span, (with a root) one inch under ground. The villagers discovering this ground covered with gold, taking a cupful of this gold and repairing to the King, reported (the circumstance.)

"At the distance of seven yojanas, in the south-east direction from the capital, on the bank of the river (Mahaweliganga) in the Tambapitto division, a brazen metal rose to the surface. The villagers taking a cupful of these brazen sprouts and repairing to the Raja, reported the circumstances.

"In the south-east direction the capital, at the village Sumanawappi, distant four yojanas, a quantity of gems rose to the surface: among which there were intermingled the cinnamon stone and sapphire. The villagers taking the same in a cup, and repairing to the Raja, reported the circumstance.

"Eight yojanas to the southward of the town, in a cave called Ambalattikolo, silver was produced."

Under this disguise of fable the historical student will be at no loss to discover the germ of a fact. Either the discovery, at this particular period, of native gold, or its renewed application to the purposes of architectural adornment, gold coins were current in ancient days and the metal itself must have abounded in Ceylon, if we may judge from a description of the city of Anuradhapura in its glory, as quoted by Forbes from a native record:—

"The magnificient city of Anuradhapura is refulgent from the numerous temples and palaces, whose golden pinnacles glitter in the sky. The sides of its streets are strewed with black sand, and the middle is sprinkled with white sand; they are spanned by arches bearing flags of gold and silver; on either side are vessels of the same precious metals, containing flowers; and in niches are statues holding lamps of great value." Sir John Mandeville, who wrote in the Fourteenth Century, stated in regard to Ceylon, amongst other great marvels, that "There dwellen gode folk and reasonable, and manye Cristen men amongest hem, *that ben so riche, that thei wyte not what to done with their godes*." Perhaps this may have to be recorded of "reasonable folk" in Ceylon yet. Cordiner, whose work was published at the beginning of this century, states:—

"Crystallized pyrites, which contain a little copper, is manufactured into buttons. Quicksilver has been discovered in small quantities. The Candian territories are said to contain gold, but the working of the mines, or gathering of the dust, is prohibited by the prudent policy of the King."

Percival, who wrote about the same period, mentioned the discovery by Colonel Robertson of a quicksilver mine at Cotta, which had been previously

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work.d by the Dutch, but which fact they had concealed from the British. Bennett gives the following statements and opinion:—

"In Ptolemy's account of the island, plumbago is included with iron and copper as indigenous; and in the year 1681 Knox mentions the former as a native mineral; it is further recorded, that in 1755, a Cornish gentleman, of the name of Thomas discovered the presence of tin ore in the island, and, subsequently, found as fine a specimen of it as he had ever seen in his native country, that Mr. Ive (the author) had also found there veins of black crystal intermixed with spar and iron, and black lead and copper ores."

To these statements, Dr. Davy thus opposes his opinion in rather an unqualified manner. "Wherever I have been amongst the mountains, I have sought more particularly for tin and copper, but in vain, having never observed the least traces of either, or of lead. It has been asserted in some publications that gold and mercury occur native in Ceylon. The result of the inquiries I have made, satisfy me the assertion is unfounded, and that neither metal in any state has yet been met with in the island."

Now, as Dr. Davy was altogether not more than three years and a half at Ceylon, (during nearly one-half of which period the Kandyans were in rebellion, and he himself physician to the forces), one would suppose that, even with his known ardour and scientific acquirements, an area of 24,000 square miles was rather too large for so minute an investigation of its geology, as would warrant the doctor's assumption that the statements of his predecessors (in authorship upon Ceylon) are groundless; and should further investigation and consequent development of its mineralogical resources nullify Dr. Davy's opinion altogether by the production of gold, silver, lead, tin, copper, and mercury, how deservedly will the tables have been turned.

The late Mr. Reckerman, Fiscal of Colombo, informed me that coal had been discovered in the island by the Dutch; but from there being such an abundance of wood and charcoal, the only fuel used by the native cooks, no notice whatever was taken of the discovery. That mineral is now become an object of such great and general importance, as to be worthy of the most particular research for the purpose of supplying fuel to steam vessels, touching at Ceylon, on their voyages to and from the colony that discovery has ever produced.

It is therefore to be anticipated, that malgre prejudiced opinions to the contrary, mineralogists may yet be induced to turn their attention to the devolopment of the geology of this magnificent country; for there can be little doubt that it will increase the present number of its known mineral productions, if it do not include both gold and silver.

Dr. Gardener's opinion in 1847 was as follow:—

"With regard to the existence of metallic veins in the mountains of Ceylon, almost nothing is known. Traces of tin have lately been said to have been met with; and it is not at all unlikely that it may hereafter be met with in greater abundance, as it is principally in the metamorphic rocks that metallic veins are found to exist; and mostly in mountainous countries for their immediate neighbourhood. As their existence, however, cannot be predicted, further knowledge concerning them will only be obtained by actual examination of those parts of the island most likely to possess them."

In 1849 Dr. Gygax reported professionally on the district of Saffragam, stating that he had discovered ores of tin, nickel, cobalt, iron, with anthracite, and we believe expressing his conviction that gold would be found, but we are not able at this moment to refer to his report.

Report of Dr. Gygax on the Geology of Saffragam.

(From the *Colombo Observer*, March 20th, 1854.)

We have now had an opportunity of perusing the reports made to Lord Torrington's Government by Dr. Rudolph Gygax, who was employed in 1847-8

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as Colonial Geologist, and sent to report specially on the district of Saffragam in the southern part of the island, where gems have always abounded, and where the greatest mineral wealth was always thought to exist. This district includes and lies around the base of Adam's Peak, and its chief town is named Ratnapura, "the City of Rubies." Much to our disappointment we find that Dr. Gygax says not one word of gold, he does not seem even to have recognized the possibility of its existence, not a word about silver, copper or tin in these reports. There is however a great deal about iron which, after all, if India and Ceylon are to be traversed by railways, may be of more importance than the more precious metal. In consequence of the large demand, iron has risen so high in England, and the expense of freight has also increased so greatly that the East India Railway Companies are offering every possible encouragement to the manufacture of iron in the country. Accordingly, the Iron Works of India have taken a new start, and it is not impossible that Ceylon may yet be engaged in turning out masses of the great civilizer. It seems a dangerous thing to dogmatize. We have always thought it safe to follow Dr. Davy (brother of the celebrated Philosopher) in the assertion that no gold existed in Ceylon, and that iron was to be found only in detached masses. But here come a number of men who know nothing of geology, and they soon afford a practical proof of the existence of gold. Then again, if Dr. Gygax is to be relied on, there is a bed of iron ore in Saffragam, 20 miles in extent, which might be made to yield "millions of tons." Cheap labour would be wanted to convert the surrounding forests into charcoal, for strange to say neither is there in the reports before us one word about anthracite, although Dr. Gygax is said to have discovered it, and although specimens of it collected by him are deposited in the Museum of the local Branch of the Asiatic Society. In these reports although we find nothing said of the more valuable metals, yet Dr. Gygax mentions the existence of a "Mica coloured like burnished copper" to be found nowhere else, but in that part of the island, and indicating, he thinks rich doposits of precious stones. This reminds us of a discovery made by a gentleman who unfortunately left for Galle this morning to proceed to India. Mr. Robert Craig, while tracing a road in Saffragam, discovered masses which he believed to contain gold in connection with what appeared to be copper, not green but with the usual copper colour. The bearings of the spot are said to have been fixed, and it was covered up for further examination. A specimen of the substance said to contain gold when first examined by Dr. Lamprey was pronounced to contain nothing more valuable than arsenic. A further examination, however, with reference to the recent gold discoveries, is said to have led to the detection of gold in Mr. Craig's specimen. We speak from verbal information, and of course under correction. Perhaps Dr. Lamprey will favour the public with the result of his observations. If gold should have been found in the specimens, it seems a pity that Mr. Craig should have been allowed to depart without being asked to point out the locality for further research. Although tin ore is not mentioned by Dr. Gygax in his reports to Government, yet he includes it in a list of minerals found by himself, and indicates Saffragam as the locality, in a paper printed in the transactions of the local Asiatic Society in 1848. This, and the facts quoted by Bennett, go to shew that tin really exists in Ceylon, and may yet be found in quantity. The search for gold, even if comparatively unsuccessful, may reveal the presence of metals which exist in the same geological formations, viz., tin, copper and lead. On every account it seems well that the country should be thoroughly explored. The researches of Dr. Gygax were cut short by motives of finance, and he was subsequently forced to seek his fortune in Australia. Thither also proceeded our old friend Major Baddely of the Engineers, who wrote much on the Geology of Canada and Ceylon. He had found gold in the former country in formations exactly similiar to some which he saw in Ceylon. We must refer to his letters in our columns to see if he did not actually assert that gold would be found in

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Ceylon. Such is our present impression. Dr. Gygax, a Swiss by birth and a man who had travelled much, was well qualified for the task he undertook, in every way, except by an idiomatic knowledge of the English language. Some passages in his report are very amusing, but they are easily enough understood, even where he uses the initials S. O. to indicate a point of the compass. We read South East—his mother German leading the geologist to give the initial letter of *Ost*. We can even fully understand and sympathize with his feelings when he descants on the folly and apathy of the natives of Saffragam in wasting nine shillings' worth of labour and charcoal to produce two shillings' worth of iron; their process being primitive and barbarous to such an extent, that even the experience of a thousand years had not "teached" them to use iron tools. He writes:—

"I must beg leave to accept my apologies for having entered on a field which does not properly belong to my researches, but it is a pitiful sight to see the poor helpless people with all the riches of nature around them," [but turning those riches to no profitable account]. We have supplied the ellipsis, and we hope the day may come when the "pitiful sight" will give way to a scene of well-directed and profitable industry; when the echoes of the Peak should resound to the snortings of the Iron horse careering over sleepers, made from the iron which extends in rich abundance from Balangoda far down into the wilds of Bintenne.

Dr. Gygax, in the first of his three reports, begins with the beginning and describes the isolated elevation on which Colombo stands, conspicuous over the flat country and paddy-fields which stretch away around it. This elevation has on its surface from 20 to 40 feet of cabook or laterite (so useful as a substitute for bricks, and as the basis of a rich soil). Below the cabook appears a mass of hornblende rock, with masses and *dykes* of yellow granite. Differing from Gardner and others, who consider cabook as a mere result of decomposing gneiss, Dr. Gygax looked on it as an "ancient alluvial deposit, raised and changed in its physical characters by the rising up of the yellow granite." The "hornblende rock," he continues, "is in some places rich in minerals, as common quartz, rock-crystal, amethyste, fluorspar, calcspar, apatite, feldspar, garnet, prehnite, chiastolith, iron pyrites, magnetic iron pyrite, molythdena, &c. The yellow granite contains about the same minerals, but singularly changed in their colour and crystallization." Much the same characteristics were found as far up as Awissawella, where iron ore occurs in detached masses or embedded in the yellow granite, but increasing towards Ratnapura. Dr Gygax, as a general rule, would pay little attention to minerals found in the yellow granite, which he considers "an analagon of basalt," representing in the plutonic formations of Ceylon what basalt is in volcanic formations. Near Balangoda Dr. Gygax first fell in with rose quartz, but curiously enough it suggested no idea to his mind of the presence of gold. "The road," he says, "goes over a red decomposed granite with large quantities of quartz. Some large pieces of quartz on the road are beautifully rose-coloured. Some pieces have been brought down to Colombo, cut and sold by the Moormen as ring-stones. Large plates of it could perhaps be obtained, and might be turned to some use as small tables." He is of opinion that the red granite, where it occurs, receives its colour from "small strata filled up with manganese and peroxide of iron."

Describing the great variety of minerals found in a stratum of grey granite, he thus notices iron pyrites: "in oblong flat knolls along the stratification of the rock, a few crystallized in very complicated forms; pale nearly silver-white, different from that of the dolomite, which renders an analysis of both desirable." In this same formation Dr. Gygax saw "an innumerable quantity of rubies of a fine rose colour, but all *splitted* and falling to powder." He is of opinion, however, that lower down in the rock, rich and profitable ruby mines might be found, like that mentioned by Sir A. Burnes as existing near Khonduz. He has never, he says, set any value on the secondary deposits of

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precious stones in the plains, most of which seem now to be nearly exhausted. But who is to mine the hill deposits? Near Pettigalakanda he was struck by the resemblance of the formations to others of undoubted volcanic origin. He wrote :—"All these rocks appear together in a great confusion, so much, that I cannot but compare it to the part of a crater. Huge masses of rocks are seen hanging over others like cooled lava. Having seen the volcanoes of the Azores, I find a strange similarity of this spot to one of the semicraters round the trachytic ridge of Setecidades Island, St. Miguel."

The strata here are "rich in chromite of iron and a fine emerald green mineral, which, I believe, to be protoxide of chrome." This substance might, he thinks, be collected by the natives, and, with the aid of cheap nitre from Bengal, chromic colours, he conceives, could be manufactured in Ceylon.

Dr. Gygax notices that on soil, apparently barren from the existence of masses of lava-like iron stone, the forest trees are rich in valuable gums, dyes, and oils. Dr. Gygax enters at large into the native process of smelting, and into the question of improved modes and the prospects of their paying, but our time and space being limited, we must pass over all this at present, and give the curious paragraph with which the report concludes.

"The slakes from the furnace are not without value, they contain a large quantity of chrome and manganese.

"A most singular fact is that in the jungle the slake does not decompose after many hundred years, and near the houses in about 2 years. I am at a loss for an explication, perhaps the influence of animal matter. It is said that the decompose slakes afford the best manure for paddy fields. This would give a chance to sell the slakes for the sake of chrome or manure, if some means could be found out to decompose it cheap and in a short time."

The reports, it will be seen, throw no direct light on the gold question, but at this moment all that refers to the geology and mineralogy of the island is of value, and will be eagerly looked into until the Gold Question is set at rest. Dr. Mac Vicar, in his paper recently reprinted by us, mentions that the substance of Dr. Gygax's researches was embodied in an article contributed to the transactions of the local Asiatic Society for 1848. We have looked into the article which consists of lists of minerals, 37 found by Dr. Gygax himself; 9 presented by friends; and 27 obtained from native dealers; with a meagre preface containing a promise, which appears never to have been fulfilled, of giving a description of each mineral. The list of minerals now actually in the Museum of the Asiatic Society, chiefly the result of Dr. Gygax's researches, is thus afforded in the most lately published transactions:—

"The minerals and geological specimens collected by Dr. Gygax in the, Saffragam District, forming a large and valuable collection. *Presented principally by Government.*

In this general collection, there are about 100 specimens of Rock Crystal, Hyalithe, Amethyste, Quartz, Zircon, Tourmaline, Disthene, Beryl, Epidote Hornblende, Mica, Garnet, Spinel, Corundum, Chrysoberyl, Topaz, Apatita, Feldspar, Binnerite, Wolfram, Rutil, Pyrochlor, Ilmenite, Titan ore, Arsenite of Nickel, Hematite, Arsenite of Kobalt, Tin ore, Chromate of iron, Chrom ochre, Molybdena, Iron pyrites, Iron glance, Magnetic iron ore, Iron ocher, Bog iron ore, Anthracite; with about as many geological or rock specimens from the same district.

A collection of specimens illustrative of the geology of Nuwara Eliya. *From Dr. Kelaart.*

Other specimens of rocks and minerals from other parts of Ceylon; including a specimens of Ceylonite, *From Lieut. Henderson, C. R. R.*

Specimen of iron-ore, from the Matura district.

Specimen of iron found at Galle in digging a well. *From Mr. G. Goonewardene.*

Some iron pyrites *From C. Whitehouse, Esq.*

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Specimens of Fossils. Dr. Kelaart says: "The Limestone in which the Ceylon fossils are imbedded, is of a very compact and pure form. In one hand specimen we observed a fossil phalange about an inch in length, apparently of a large Saurian reptile. This unique specimen is now in the Museum of the Asiatic Society of Ceylon." Dr. Kelaart's Zoology of Ceylon, p. x.

Looking at the frequency with which, to the confusion of Geological theories, gold has been found in porphoritic rocks, it is interesting to know that rocks, of this description, were noticed by Dr. Gygax near Balangoda.

THE GOLD QUESTION.

[For the Government License to diggers, see page 3 of this pamphlet.]

The price fixed for a License would not perhaps be too high, if only nuggets of gold, or dust in quantity had been found. But the application of Mrs. Glass's rule in cookery is obvious: "First catch your hare." Government ought to have been satisfied that a source of revenue existed before they attempted to derive revenue from it. We are bound, however, to concede that the preservation of peace and order were objects in view in the issue of Proclamations which are doubtless repressive in their tendency. It will be observed, that although in the sale of Crown Lands, the rights of the Crown to mineral deposits were especially reserved. There is at present no prohibition to private parties to search and mine their private lands. If in searching the quartz beds which, in planting coffee, cultivators so religiously avoided, rich deposits should be found, of course the finders will at once inform Government! The prejudice against quartz in planting operations may go far to answer the question. "Why, if nuggets exist, were they not discovered in all the digging connected with 300 estates of 60,000 to 70,000 acres, spread over ranges of hills and stream?" Of course "prospecting" is now going on everywhere, and we think the bed and sources of the Kelaniganga about Yatiyantota and Ambagamuwa ought not to be neglected. We recollect being much struck with masses of beautiful red quartz on one of Mr. Anstruther's estates which we saw in 1849. And it appears from the valuable extracts from Earp's little work which we this day afford, that that gold is generally found in quartz at the foot of the *lower ranges of hills*, such as those of Kadugannawa, Dolosbage, Ambagamuwa, &c. Our friend of the "Examiner" dwells much on slate formations, but we have none of these in Ceylon. Gold is found in slate formations, but much more frequently and much more plentifully in quartz. Amongst the circumstances which are now revived is the fact that a French cook who was with Major Blackall in Ceylon, used to search for gold in the bed of the Mahaweliganga. He is said to have gathered particles of the metal to the value of £2, but with a result which it is but too probable may attend the present more extensive researches—the quantity of gold found did not pay the labour expended on its collection. The well-known hill near Kandy called Rangalla signifies "the gold mountain," and we are told that the name of a coffee estate in the neighbourhood signifies "the gold mine." Dr. Kelaart, in his recent work on the Fauna of Ceylon, has the following passage:—

"Iron pyrites, mangnetic and hematitic ores of iron are abundant in the district. Long before Europeans visited Nuwara Eliya, the natives used to come up to smell iron from the ferriferous rocks found here. Gold is also said to have been discovered here."

Our brother of the "Times" however states, in reference to a specimen of red quartz forwarded)to him from the mountain sanatarium, that it contains yellow mica but no gold. The gold must be looked for lower down. To bring together all the information possible bearing on the subject, we reprint below some passages from Pridham's compilation and an extract from the late paper by Dr. MacVicar.

(*From Pridham's Compilation.*)

"From the nature of the rocks other metals might have been expected in Ceylon, says a learned geologist, who mentions hat he has sought in vain

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among the mountains for tin, copper, and lead. All three, however, are reported to exist by persons who have themselves discovered them, and quicksilver and plumbago (kalu miniran, *Singh.*) which of late years has been largely exported to England, may be added to the list. Gold and mercury, which are said to occur native in Ceylon, according to this writer are rarely found, but small lumps of the former have been at times met with. 'Did any,' he continues, 'of the common, and what is more, of the precious metals occur in Ceylon, it would have been known long ago; for the natives are inquisitive and curious, and being in the habit of searching for gems, and collecting everything that glitters, or that is in the least likely to sell, even bits of iron pyrites and ores of iron, it would be very extraordinary were they to pass unnoticed substances more attractive, with the value of which they are well acquainted.' I may cursorily observe that this remark is rather applicable to the natives of the southern, than any of the other provinces of Ceylon, and that the opposite conclusion of another learned geologist, embodied in the note,* is nearer the truth. Dr. Davy's erroneous conclusion on these points must have arisen from the imperfect opportunities at his disposal for the survey of the whole island, not more than one-third of which he ever visited, and not from any want of sagacity in observing, or ardour in pursuing the various branches of natural science. Stahltein, or crystalized pyrites, impregnated with a little copper, is used by the Singhalese for making buttons."

From Dr. Mac Vicar's Paper.

"This humble view of Ceylon I take from considering its geological structure, which is such, that it can never give anything better on the large scale than a very poor soil and which holds out no promise of yielding either minerals or metals worth the mining.

Hoping, that it might be otherwise, the Government of Lord Torrington some years ago, when extravagant hopes of the resources of the island were entertained, appointed Dr. Gygax, an accomplished mineralogist who happened to be on the spot, as its geologist, to explore the country with a view to economic objects. But the result was wholly negative. Except a very friable plumbago which has been long mined by the natives and exported by the English merchant, to line the hold of ships previously to putting in more valuable cargo, such as coffee, nothing of any value was found *in situ.* Dr. Gygax's report is now, doubtless among the archives of the Colonial Office in Downing Street, and therefore accessible to the naturalists of this country; and the collection of minerals which he made for the Government of Ceylon was very handsomely given by Lord Torrington to the charge of the Ceylon Branch of the Asiatic Society, in whose Museum at Colombo it is now deposited, and where it can be inspected by any one who has an hour to spare. Let the mineralogical traveller prepare for disappointment, however, if he expects Ceylon to realize in any measure the conception of an island of gems. Dr. Gygax found only thirty-seven mineral species in all, the commonest, such as quartzes, felspars, and mica, included. His results have been published in the Journal of the Ceylon Branch of the Asiatic Society for 1847."

With reference to our extract the other day from the Mahawanso about the gold miraculously produced in the forms of roots and twigs, it is a curious coincidence, and tends to confirm our idea of a real discovery of gold being indicated, that in California gold sometimes resembles twigs. In connection

* "The sciences of geology, mineralogy, &c., in all their branches are but imperfect understood by the natives, notwithstanding Ceylon is the depository of such an extensive variety of specimens. Their attention seems never to have extended much beyond the valuable gems and the mineral ores. As to a thousand other subjects, both on the surface of the earth and imbedded in the hidden substrata of nature, so interesting to men of science, they have allowed them any almost undisturbed repose, never having exerted themselves either to quarry out a knowledge of their latent properties or ascertain their intrinsic worth."

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with the report of a case from Manaar contained in the Jaffna *Morning Star*, we find it stated that "among the ignorant, illiterate portion of the native community, a notion is pretty generally held that to ensure success in search of hidden treasure, a human victim must first be sacrificed to propitiate some deity." It is to be hoped that few persons with such notions will be found amongst the searchers on the present occasion.

We find we were in error in our last in giving "Gold Plain" as the interpretation of Ruanwelli. "Gold Sand" is the correct one. The Native correspondent to whom we have been indebted for much information already, writes as follows:—

"*Ruanwelle*, I think, strictly means 'gold sand,' and not 'gold plain.' You are quite correct in supposing that 'Ruanwelli dagob' means the "dagob covered with dust."

"Ruanwelle is situate in Three Korales, and cannot be the place mentioned by Turnour.

"Ruanwelli dagob is the well-known dagob of that name in Anuradhapura.

"A detailed account of this temple will be found in the Thupawansi. I shall look into it, and see if it contain any information that may prove interesting on the subject of gold.

"I remember reading somewhere that the *Ruwanwelli* dagob was so called from its having been covered with gold or gum-dust (*Ruwan* also means gum). I thought the passage was found in the *Thupawansi* (History of Thupas or Dagobs), but on taking a hasty glance of the work last night I could not find the passage. According to popular tradition, the Ruwanwelli dagob was so called, because the *gods caused gold sand to be strewn* on the square of the dagob in the days of its consecration.

"It is known in Pali Historical Records by the names of *Hema mali*, *Ratana mali*, *Sonnamali*, *Ratnawaluka*, Cheteya or Thupo. They all signify *gold-sand* or *jewel-sand* dagob. The term also might mean 'gold-mountain' or 'jewel-mountain.' The author of the *Thupawansi* in his introduction says, 'I proceed to relate the history of *Ratna Mali Cheteya* (gold or jewel sand, Cheteya) which is refulgent with a vast mass of gold, jewels, gems, &c., &c."

March 20, 1854.

I have this morning seen a native of Hapitigam Korale, who tells me that there is a hill as well as a village of the name of *Maldeniya* in that Korale, and that the distance from that village to the "diggings" is only about 1½ or 2 miles. I also learn from him that the distance from Maldeniya to Belligal Korale is about 6 or 7 miles. I have also heard that Maldeniya Unnanse, although resident at present at Kurunegala, is a native of Maldeniya in Hapitigam Korale.

We have been endeavouring to identify the places mentioned in the Mahawanso, where precious metals, gems, &c., were found, but, for want of a good map of the country surrounding Anuradhapura, with but indifferent success as yet. The gold seems to have been found in Bintenne and the silver in Saffragam. We hope to pursue our researches on this subject. The intelligence from the diggings, as far as it is certain, is unsatisfactory. Gold continued to be found, but not in remunerative quantities. A gentleman who visited the scene of operations on Friday, writes:—

We found the men (except two laid up with fever) digging out the sand from what is the river bed in wet weather, placing it on an inclined board with an iron grating at the end to receive large stones, all the earth and sand falling into a box with three compartments. Into the first of these the one under the Tom, the gold falls; when full, all the sand and stones contained in this box are washed by hand in a large flat tin pan. I saw the best day's work that has yet been done after 8 hours' labour assisted by coolies, and in every possible way they got four dwts. (penny weights) value 15s., so these diggings will not in my opinion do. That there is gold to be had in quantity they have yet to prove, and Power, who is appointed *Gold Commissioner*, started

this morning with Bradley and another to prospect up the country, taking Gordon's bridge, so the diggings may approach Cotta Galle. That there is gold in the Maha Oya at the old Morrotie ford I've not the least doubt, only if it pays to wash it; to natives it may, but at present decidedly not to Europeans."

Mr. Power, we understand, wrote in to Government on Saturday to say that "a piece of gold" (size and weight not afforded) had been found 8 miles above the diggings, "with more to come." We hope to hear further before going to Press. The fact of two of the diggers, being down already with fever, is ominous, and we have heard that some sailors who had left their ships have asked to get back again.

Henry Temple, one of the diggers, has just been in our office with a companion who is very ill from fever. He demurs to our suggestion that the diggers are likely to find more fever than gold, and at our request gives us as follows the names of the now historical seven, rendered famous by the exception made in their favour in the Government Proclamation: Henry Temple, Wm. King, Charles Langley, James Mabley, John Wilson, John Philips, Wm Bradley.

Thirty of the police force are already at the diggings, and we have heard that a company of the Ceylon Rifles are under orders, if required for the same destination.

P. S.—Since writing the article on the reports by Dr. Gygax, we find that there was a subsequent Report, dated Jan. 1849, in which he announced the discovery by him of gold in connection with iron pyrites. Another fact is that Mr. Talbot, the Government Agent of the Southern Province, has forwarded to the Colonial Secretary what appears to be a nugget of gold, but which bears the appearance of having been hammered. The native who presented the piece of gold to Mr. Talbot states, that he found it in the state in which it exists near Ratnapura. Then it seems that gold actually does exist in the rocks at Nuwera Eliya, and that specimens are about to be analyzed to settle the quantity. And finally, a letter from Kandy asserts that 24 miles from that town on the Trincomalie road, gold has been found in larger quantity than at the original diggings.

We now find that the piece of gold reported by Mr. Power was produced to him by a headman—that Dr. Ellery pronounced it to be entirely *without alloy*—that it was found at the village Dambedeniya (an ancient capital, where coins of gold and copper were formerly struck)—and that the headman had promised to return with more specimens and with the persons who had found them!

GOLD FINDING AND GOLD WASHING.

At the present juncture we believe we cannot better meet the wishes of a large portion of our readers than by presenting them with the following clear and simple directions for finding deposits of gold and separating the metal where it does exist from extraneous substances. We quote from *the Thirty-fifth Thousand* of a little work entitled "The Gold Colonies of Australia," by G. B. Earp:—

How to Look for Gold.

The first step toward this is to inform him [the Emigrant] under what conditions it is found in the principal gold countries of the Northern Hemisphere, to which the precious metals have, for the most part, been heretofore confined.

In the mines of Russian Siberia, gold is found mixed with sand and coarse gravel; the sand being evidently a disintegration of quartz. Pebbles of the latter substance, when broken up, yield it in considerable quantities, and in lumps, answering to the "nuggets" of the Australian mines. The hundredweight nugget, of which we have spoken, was an immense quartz boulder of this description, and this is the most common form of gold nuggets in Australia.

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It is also found in granite, schists and other igneous rocks. This is experienced in Australia. It is plentiful in Russia, where greenstone, porphyry and serpentine are found in the older limestones. In this case, it is often associated with platinum and chromate of iron. The gold-bearing detritus is not so universal as in Australia, but is found at intervals.

In Brazil, gold is found in primitive granite, gneiss, hornblende, and mica, or, rather, in a disintegration of these rocks, as it exists generally in a stratum of these resting on the rocks. As in Austtalia, it is frequently found on or at a few inches, below the surface. Sometimes it exists in scales, or lumps, mingled with sand both in the beds and on the banks of the stream, as well as in grains in alluvial loams. All these forms of gold exist in Australia, as is apparent from what we have before stated.

Sometimes gold is found in South America, mixed with the sulphurets of silver and iron, and again traversing rocks of mica slate. In Peru, ores of iron and oxides or copper contain gold in large quantities. In the bottoms of gullies, filled up by the accumulation of sand, nuggets of some size are often met with. This is precisely the case in Australia.

In Europe, gold is sometimes found in flakes, at some distance below a sand or gravel bank, and is often accompanied by titaniferous iron. It is seldom worth working, and is thus found on the banks of the Rhine. The Spanish mines, once highly productive, are mostly composed of ferruginous sand.

African gold is usually found in the sands of rivers, only, perhaps, because the people are not sufficiently intelligent to trace it to its matrix. Asian gold is generally found under the same conditions, probably from the same cause.

California is herhaps the gold district, the geological features of which most closely resemble those of Australia. We have stated elsewhere that Mr. Hargreaves, the practical discoverer of Australian gold, was so struck with the resemblance of the California mountains to the outlines of the Australia Blue Mountains, that he returned to prosecute a search for the precious metal, and found it as he had anticipated.

In California, the interior mountains are composed of porphyry, limestone &c.; these forming the outlying spurs, beyond which the rocks are volcanic, shewing lava in some places, and being covered by loam on the Pacific, granite appears with schists and metamorphic limestones; these are traversed by veins of quartz, containing gold. Humboldt says that the prevailing geological types of equinoctial America, of which California is an extension, are porphyroid rocks associated with trachytes; and these, though in opposition to scientific theories, contain abundance of gold. Some of these porphyry formations rest immediately on primitive rocks, others on clay or talcose slate, with transition limestone. These porphyries are rich in gold, the detritus of similar rocks.

As a general rule in searching for gold in Australia, the rocks should be either quartz or quartzose, though it is often found in clay-slate and other rocks previously mentioned. It is sometimes found in quartz of a rusty appearance, from the mixture of iron; the mass is then frequently cellular or honey-combed as was the case already recorded of Dr. Kerr's hundred-weight of gold. Granite rocks often contain auriferous veins of quartz, and when this is the case in Australia, gold may be expected from the granite itself. Gravel itself is a detritus of quartz, and hence the gold is frequently found amongst and *beneath* gravel. When schist rests on granite it is often auriferous, the gold being scattered in particles in the clayey rock.

In Australia, it is found, as a general rule, that when smaller particles of gold are found in a stream than they are higher up, the stream should be traced still higher, when the matrix will be arrived at, the river itself having brought down the detritus. The sources of gold are found to be two-fold; the metal has either been diffused in certain rocks which have decomposed, or has been spread over the surface of the hills at some remote period, by the violent action of water. This is the origin of all alluvial gold beds.

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Contrary to the usual law of metals, where gold is concerned, it is the upper and not the lower portions of veins which are prolific. This arises from the violent action of water on the surface,—and hence, in general, arises the argument that there must be mountains to produce much gold in valleys. It is generally found, moreover, that moderately high mountains produce the most gold. The most prolific gold-fields of Russia are at the base of hills not more than 1,500 feet high whilst those at the base of hills rising to 5,000 feet and and upwards, are not nearly so prolific in gold. Hence it is probable that the most fruitful discoveries in Australia have yet to come, and the gold-fields of of Port Phillip are a direct proof of the argument as the hills where gold has chiefly been found are of moderate elevation.

A brief notice of the distribution of gold generally will be of use to the intending emigrant.

The diluvial deposits are found in the beds of streams and in the valleys around, the latter having been at one time covered with the waters of the stream. Gold is also deposited in a limited height above these valleys—frequently to the summit of the higher lands in the neighbourhood, these having been at some remote period under water also, when the gold was deposited as in the streams. The metal, under these circumstances is found in sand, gravel, on clay beneath the gravel, and amongst the débris of rocks, and is continuous as to its quality and frequently as regards the given contents per cubic fathom. Diggings where the deposits are of this nature are the most productive, and reward the most unskilful miner; no machinery beyond a cradle, or some equally simple contrivance, is requisite. The materials for carrying on the pursuit are easily procured—the returns quick—and the whole establishment is readily removed as the gold becomes exhausted.

Much of the gold found in these diluvial deposits is wasted from the rude manner in which it is sought for; the miner being unable to detect it except in lumps or scales which are palpable to his eye. In Australia, numbers of reputed exhausted diggings will be well worth going over again with more skilful appliances, and the labour will be comparatively easy, from the previous loosening and removal of the earth from its bed.

The gold has not been generated in the streams, valleys and high lands, over which it is scattered;—but has been washed down from the primary or non-fossiliferous rocks, the most common of these gold-bearing rocks being quartz, granite, or perphyry, and sometimes slate, the gold soil of the lower lands being merely the *detritus* of the primary formations.

The intelligent miner will hence look for the seat or matrix from which the gold has been carried—not by itself, but imbedded in rocks which have subsequently been abraded and washed away by the violence of the floods, the gold itself, from its weight, remaining nearly on the same spot in which is finally parted from its rocky envelope. The veins and beds in which it is orginally found, generally exist in mountains of secondary height, and these are the more likely to contain gold, the more they are parallel to the meridian. Under these circumstances it is found imbedded in the rocks, often in a state imperceptible to the eye, the nuggets which are found being no doubt the result of fusion of the primary rocks when the latter were in a state of ignition. Rock mining can only be carried on successfully by machinery of various kinds, as pumps, stamps, &c.; and this machinery, being of a costly nature, must be permanent, so that great judgment has to be exercised as to the productive qualities and extent of the gold bearing rocks, as a large outlay must be made before any profit can arise. Even at the best, gold veins are of a temporary nature, as a few years' continuous labour exhausts the product, and it is now well known, that in the majority of veins, at very moderate depths, the gold gradually and regularly diminishes in quantity, though in some cases it improves slightly in quality, yet at last the expense of producing the metal is greater than the yield. The history of old gold mines does not prove the veins to be entirely exhausted, but only that the

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gold exists in such small quantities, that a gradually-increasing loss arises upon each ounce of gold produced, from the increased expense of pursuing the vein deeper.

Gold mines are, however, found extensively in the primary formations, in which the metal is sometimes intimately mixed with the rock generally, or it may be in lodes or veins spreading about like the twigs of a tree, sometimes thick and sometimes scanty, so that the search for it is not only tedious, but highly expensive, from the great mass of rock which has to be reduced to powder in order to obtain a small quantity of gold. It is for this reason that the gold mines of the Merionethshire and Wicklow mountains are not considered worth working. Indeed, although gold veins are worked in many countries, it is only in California that the gold rocks have been found worth working on a large scale, and even in California the sums spent in the unsuccessful attempts at rock mining are very large, as some of the English companies formed for that purpose can testify.

It is then to the rivers or to the action of water generally that we have to look for the most profitable supply of gold. Instead of hard rock, soft sand has to be scratched, and the search is often rewarded—in Australia beyond any other gold country—with bunches and lumps of the rich metal, varying in value from a sovereign to 4,000 sovereigns, while lumps of the value of a hundred sovereigns, or more are common prizes.

Gold is again found overlying the diluvial deposits in recent earthy matter, and has been slowly and gradually brought into the valleys and streams by the action of rain torrents, &c., in the neighbourhood of auriferous beds; and not always in the neighbourhood of these only, but gold-bearing rivers are frequently beyond the primary formations. Gold, under these circumstances, is the mere concentration of many ages, by the action of water on earthy and ferruginous soils, which for hundreds of miles may contain traces of gold throughout, but yielding so small a percentage per ton, that by no known process of extraction can it be rendered available. Some of the states of North America, Mexico, and Brazil contain gold under those conditions, but hardly worth the working; the object being not so much to find where gold exists—for next to iron it is the most abundantly distributed metal—but to find where it exists in quantities sufficient to repay the labour of gathering it.

The last condition under which gold may be expected to be found is the one before alluded to, viz., in previously-worked alluvial and diluvial deposits, in which, from imperfections in working or washing a portion escapes, which, from its specific gravity, settles in the earthy contents of the workings and rivers, and as the earthy matter is annually washing away, while most of the gold remains, after a lapse of time the working of such localities over again will be found to be profitable. But as new fields in Australia will be abundant for ages to come, we need not pursue this matter further.

The great gold desideratum of our day is a solvent which shall loosen the metal from the rock without the tedious and expensive process of pounding, separating the gold from earthy matter with less loss than is at present the case. The various amalgamating apparatus are too tedious for poor ores, and unnecessary for rich ones. The well-known simply affinity of mercury for gold will secure the smallest particle; but unless water be abundant, and something like 200 grains can be obtained per ton of earth, it will not yield any profit worth notice.

It has generally been found that at a distance from the mountains in which auriferous streams arise, there is a point in which the gold is nearly an impalpable dust, and that on going up the stream the particles sensibly increase in size, till at length they assume the appearence of scales; higher up still, the metal increases in coarseness, till the gold is found in its natural roughness as if fresh broken from the matrix, being more or less interwoven as it approaches its source. As it approaches this, pieces are found to which

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portions of the native rock are attached, so that by carefully marking these indications, the shrewd observer is able to form a good guess of the vicinity of mines which will amply repay the acuteness of his observations.

Our space will not allow us further to enter into geological considerations, and we will now give the reader a few mineralogical characteristics of gold, so that he may know it when he finds it, this not being so easy a matter as he may imagine. False alarms without end are of constant occurrence in all the Australian colonies, the discoveries turning out neither more nor less than pyrites of some kind.

Gold is yellow, nearly silver-white, and steel-gray; the yellow is the most common in Australia. Its lustre is shining which is increased by a little rubbing, when it will not again tarnish from its non-oxidable qualities. In colour and lustre it may easily be mistaken for iron or copper pyrites. A cut with a knife or a blow with the hammer will at once rectify this mistake as it is soft, whilst iron pyrites is harder than steel, and if struck it flattens, whilst copper pyrites is not malleable, but crumbles before the blow. Mica is again often mistaken for gold, but the weight of the latter will at once point out the mistake, as mica is light. The steel-gray gold may be mistaken for platinum, but as it is rarely found in this condition in Australia, the difference is unimportant, and can only be detected by experience or assaying. The softness and the weight are the best tests. Is is softer than iron, copper or silver, and harder than tin and lead. Hence it is scratched by the three former metals, but scratches the two latter.

When broken, the edges are uneven. It is sometimes found in a crystalline form, and when so, its value is much increased, as being a rare mineralogical specimen. Sometimes it occurs in thin leaves. Should all the above indications not prove satisfactory, the blow-pipe, with which every emigrant should provide himself, is a sure test. Before this it fuses readily, and remains unaltered, whilst copper and iron pyrites have a sulphurous smell and rapidly diminish.

A bottle of nitric acid is sure test. If the mineral found be gold, it will not touch it; if a baser metal, with the exception of one or two not commonly found in Australia, violent action takes place and gaseous fumes arise. By this means spurious gold dust may be detected: if it be pure, no action whatever will take place, and the liquor will not be discolored; if impure, violent action will take place, red vapour will arise, and the acid will be discoloured.

The weight of a lump of quartz as estimated by poising it in the hand is generally sufficient to determine whether it contains gold or not, quartz having a specific gravity of about 2½, whilst the specific gravity of gold is from 18 to 19. This accounts for gold being sound in grains and nuggets—the water having had sufficient power to break up and wash away the lighter rock, but not the gold itself. Hence it may be inferred that when large lumps of gold are found, the matrix itself cannot be far off—from the impossibility of the current washing these to any great distance. On the other hand if the gold be in dust or scales, it may be, and is frequently distributed over a large space of ground.

The unpractised miner is apt to take several substances for gold which have no alliance with that metal. The first of these is yellow mica: this may, however, be readily distinguished by its lightness. The next is iron pyrites. This is as easily distinguished. Stick the point of a penknife into a scale of gold, and it will penetrate it, but the pyrites would be found too hard for this. Place a little of the substance on a shovel, and put it on the fire. If it be pyrites, a strong smell of sulphur will be perceived, and the residuum after the sulphur is driven off will become red iron rust. Dissolve the mineral in muriatic acid, and add a few drops of nitric acid. Add to the solution a little hartshorn, and, if iron pyrites, rust is precipitated. With a solution of

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nut galls common ink is produced. With prussiate of potash Prussian blue is formed. Any of these tests will decide between iron and gold.

Should a lump of quartz be suspected to contain gold, the fact may easily be established as follows:—Pound the quartz finely—the finer the better. Boil this for a considerable time in an equal mixture of nitric and muriatic acid, filter the solution through linen or cotton. It will destroy these, but that is no matter; the experimenter must also be careful not to get any of the acid on his clothes, or it will destroy them. If he burn his fingers with the acid, he will not do so a second time. Now add carbonate of soda to the solution when cool, and this will precipitate all baser metals. Filter again, and add a solution of oxalic acid till it ceases to effervesce. The gold will now be thrown down in the form of a black powder, which may be converted into the usual form by melting.

We will now notice a new process for separating the precious metal from black sand and quartz, which has been patented in America. When quartz is stamped, it is found experience, that from the softness of gold, a great portion of the laminated filaments are rubbed off, sometimes amounting to from one-fourth to two-fifths of the metal; and this filament can never be detached from the iron and sand by any plan of amalgamation. The patentee, who has taken his idea from Dr. Percy—who propounded much the same thing in a paper read before the London Chemical Society—uses neither more nor less than a fresh and liquid bleaching chloride of lime. The mode of its action will be readily understood from what we have before stated, and the ingenious miner can easily try the effect of this hypochlorous solvent for himself.

As gold readily melts, it may be thought that, by heating a piece of quartz beyond the melting point of gold, this metal will flow from the quartz. This is not so; the gold will be melted, it is true, but it will be in the matrix as before. The quartz is infusible, and in order to get at the gold, it is necessary to render it fusible. If to finely-powdered quartz we add several substances, this effect will be produced. Mix carbonate of soda with the finely-powdered quartz, and when it has arrived at a certain heat it is quartz no longer but melted glass, through which the gold, if any, will sink to the bottom of the crucible.

But suppose the gold and quartz to be melted, the same difficulty presents itself as to how to get gold from the quartz-glass which has been formed. We must have recourse to something which will take the whole of the gold from the glass, and which will readily give it back again in its pure state. This condition is answered by mixing with it a quantity of lead. This metal takes up all the gold, and may be readily separated from the quartz-glass. We should here remark that lime and oxide of iron, as well as some other substances, will convert the quartz into glass as well as carbonate of soda. Into the nature of these it is not necessary to enter, as we are only showing the principle of gold smelting, leaving the miner to apply it in practice.

Having now got our mixture of gold and lead, the quartz-glass may be taken from the crucible and thrown away. The remaining step is to separate the gold from the lead. This is done by a process termed "cupeltation." The miner would scarcely have time or experience to effect this process, but it will not be uninteresting to him to know its principle. When lead is heated to a high temperature, it rapidly absorbs the oxygen of the atmosphere, and, if heated to redness, the oxide thus formed, melts. But gold never oxidises, and cannot be volatilised at any heat procurable in an ordinary furnace. This distinction in the properties of the two metals causes their easy separation. Many substances readily absorb melted oxide of lead, amongst which is bone-ash, which substance, compressed into as solid a state as possible, will take up all the lead and leave the gold behind; the lead also, if in sufficient quantity, taking with it all baser metals, leaving the gold pure, or alloyed with silver only, and we have previously given the method of separating this. We may, however, mention, that when silver is to be "parted," as it is termed,

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from gold, the latter must be melted with three times its weight of silver, and then hammered or rolled out thin before it is exposed to the nitric acid, which dissolves the silver and leaves the pure gold behind.

In powdering the quartz, the process is rendered quicker by making the quartz red hot, and then plunging it in cold water. If the quartz, as is sometimes the case, contain magnetic iron, dry the powdered mass thoroughly, and apply a good magnet, which will take out all the iron, and thus save an immense trouble in getting the gold pure.

Gold Washing.

From our previous extracts it will be seen, that so abundant is gold in some parts of Australia, that it has repeatedly been obtained by a kick of the foot, and by boys and men with a tin dish. These modes are, however, too primitive to be profitable, except accidentally so. A tin dish is no bad test of the soil when "prospecting." Wash the soil, pouring carefully away the mud, leaving the heavier portion at the hinder angle of the pan. Then amalgamate the residue with a little quicksilver. If there is gold, the quicksilver on kneading it will become solid, and form a pasty mass. If the quicksilver remain liquid, and in globules, there is no gold—try again.

The Hungarian method of separating gold would answer well in Australia, where for the most part the gold is coarse and heavy. Get a long broad board, grooved longitudinally, and nail a thin strip of wood all round it, except at one end. Nail also a few strips of wood across the inside of the trough, to stop the gold, whilst the soil washes over. Give the trough a slight incline against a bank, and put your gold earth at the upper end. Pour water over this, and if there is gold it will all remain from its weight in the upper grooves, whilst the soil being light, will be washed away. Where people work independently, as in Australia, and gold is coarse, and water plentiful, this method, simple as it is, would be a very efficient one.

The following is just as simple and efficacious. Carry with you a large wooden bowl, and put into this, or dig out of the bed of the stream with the bowl, a quantity of earth; stir this well in the water, and let it rest a minute or so; then throw away the water, and repeat the operation six or seven times. The gold, with care, will remain at the bottom. A bowl with five or six pounds' weight of stuff may be washed in a few minutes, and this method will be quite as productive as the "cradle," in which, by the testimony of all parties, half the gold is wasted. The sediment may be treated with quicksilver as before, if required, and the superfluous quicksilver may be wrung out through a piece of wash-leather, leaving the gold amalgam behind. We shall by-and-by show how to recover the quicksilver.

We are here supposing the absence of mechanical contrivances, many of which are more ingenious than useful, and that the Australian miner has chiefly to depend on his wits and his arms. To such, the following easy method, well known in South America, is worth more than the "radle," and is attended with none of its inconveniences. Make a wooden gutter, the longer the better; very slightly incline it, so as to allow the water to run off; put your soil at upper end; and if the gutter is long enough, all the soil may be washed away, leaving the gold at the top, or at most, not half way down. The running water thrown on will carry off all the light soil, and the stones may be picked out by hand. The gutter, to be efficacious, should be wide, and pretty deep, and if long enough, there would be no fear of losing any gold. Such a contrivance where a party is working, would, in point of producing, beat a dozen cradles.

A shallow tub or pail makes a first-rate washing machine. The manner of using it is this:—Place the tub in the water, an inch or two under the surface, then stir up the sediment,—the running stream will carry all the light soil away, and by-and-by you will have a respectable tubfull of gold; the stones may be picked out as before, and the remainder either separated by hand or with quicksilver.

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The cradle, as used in California, is a rude affair, and acts upon some of the preceeding principles. It is eight feet long, and stands on rockers, whence its name; at its head it has a coarse wire grating, the bottom is rounded with small cleets across. Four men are requisite to work it. One carries the soil and empties it on the sieve, another digs it from the gold bed, the third rocks the cradle, and the fourth supplies the water. The gutter we have spoken of is a better, though not so compact a contrivance. In the cradles, the sieve or grating keeps out the stones, the water clears away the earthy matter, and the gravel gradually finds its way out at the foot of the machine, leaving the gold and sand above the upper cleets. This is taken out, dried in the sun, and the sand blown away. The above description is from a despatch by Colonel Mason, given by Professor Ansted. It would be useless to give any further description of gold-washing contrivances. All are on one or more of the above principles, and he must have little ingenuity who could not both make and use them.

The tools necessary are just as simple, and consist of a crow-bar, a pick, and a shovel, to which may be added a blacksmith's striking hammer for breaking any rock supposed to contain gold. Other implements are unnecessary. The crowbar is indispensable. If quartz has to be crushed or ground in any quantities, mills are necessary, but these we shall not stay to describe, as they involve a great expense, and are the work of the engineer. The above improvisatory methods are sufficient for all ordinary purposes.

Quicksilver is recovered from the amalgam by distillation, leaving the pure gold behind. Quicksilver machines may be purchased in London, and would be found highly serviceable where the emigrant can afford to go out well equipped for his work. But let him avoid encumbering himself with ingenious mining *impedimenta*. When on the gold fields he will soon be rich enough to indulge in scientific whims, and by that time, indeed even now, he may purchase them in the colony.

Much gold is now lost in Australia by the cradling method; but by the methods we have described, not a particle need be lost, and the digger may work independently of others; whereas, in cradling, he must be in partnership. Mr. Rudder, now in New South Wales, but formerly in California, gives the following variation on the cradle, but that of Colonel Mason, above described, is in our opinion preferable:—"The cradle," says Mr. Rudder, "should be four feet long, twenty inches wide, and have a slide of two feet under the hopper which leads to the grating—not mere wire netting, as the use of this is to keep stones out of the machine." This is a complication of affairs, and gives two feet less in the inclined plane than Colonel Mason's, which almost anyone is carpenter enough to make for himself. The inclination of the cradle should be half an inch to a foot.

Thus much for the theory of gold washing. We will now inform the intending emigrant how it is applied in the Australian gold fields. From what has been previously stated, he will readily comprehend the distinction between river diggings and dry diggings, the latter being on slopes where the water has ceased to operate, having left the gold at some remote period. At the dry diggings, being away from the stream, the gold is usually found near the surface. We will suppose a party "prospecting," or in search of new diggings. They provide themselves with crowbar, pickaxe, shovel, and prospecting pan, the latter being the high-sounding term for a large, round, flat-bottomed tin dish. As soon as they perceive the geological indications of gold, they fill their pan and carry it to the stream, carefully washing the contents out, all but the gold, which sinks to the bottom. By filling the pan and washing it out two or three times, a few minutes will decide whether the soil contains gold, and whether it exists in paying quantity. If the spot promise to be remunerative, to work goes the cradle, which has been sufficiently described. This is vigorously rocked, water being poured on so as thoroughly to separate the mud, clay, and earth from the stones, which are picked out by hand, a glance being sufficient to determine

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whether they are pebbles or nuggets of gold. These, however, rarely occur in clayey soil. The cradle is again filled, and so on till the accumulation of mud at the ledges is sufficient for examination. It is then scraped out and examined, the larger gold being carefully picked out, and the remainder washed clean; though much gold is lost for want of quicksilver to take up the fine particles scarcely visible to the eye.

River diggings are, however, the most valuable, and it is in these that "nuggets" are chiefly found. Here more than a superficial examination is necessary, as gold will not in all probability be found at the surface, the holes and crevices in the original rock bed of the stream containing the greatest prizes. The soil, too, may be gravel, in which case, as we have previously explained, when considering the geological character of the gold fields, the precious metal will have percolated through the upper stratum, and will have descended to the bed of the stream below, where it must be sought for. The shovel and the prospecting pan will soon decide this. If after removing the upper stratum they reach a tenacious clay, a blue colour being considered the best, they will know that this has never been disintegrated by the current, but on the contrary, consolidated, and on the surface of the clay bed they may be pretty certain of finding gold in a comparatively thin layer. Should the prospecting party determine on working a spot presenting the true indications, they dig a trench, and by means of "back troughs" divert the course of the stream. The bed of the stream being thus laid dry, and all the large pebbles and gravel removed, the clay stratum is exposed and washed as before.

It will be well to watch for any old bed of the stream, now dry, but one over which the water has formerly flowed. Such dry beds are not unfrequently most productive. It is easy to tell where, in these old beds, an eddy has formerly existed, and there should the search be made. They will here dig till they reach the original bed of the stream, when the gravel will have to be removed as before, and the clay bed will have to be arrived at. The holes thus dug are sometimes of considerable depth, and if a good yield is obtained from the crevices of rock or pockets, as they are termed, the bed is followed and tunnelling commences under the adjoining banks. Sometimes hundreds of pounds' worth are obtained in a single day by parties who possess even the little mining experience which we have endeavoured to impart, whilst others less instructed will be digging away at a hole a few yards distant, without a chance of obtaining a single particle of gold.

(From the *Observer*, March 23, 1854.)

IRON AND ANTHRACITE.

Colombo, 21st March, 1854.

To the Editor, "Ceylon Observer."

SIR.—Observing in your issue of the 20th inst. a remark that Dr. Gygax is "totally silent as to the existence of anthracite in Ceylon, though he is said to have discovered it," I take the liberty of informing you that the finest specimen of anthracite in the British Museum is labelled as being from "*Saffragam, Ceylon.*" It presents a flat surface of nine to twelve inches, and is beautifully iridescent like some of the best descriptions of coal. It attracted my attention in 1846, on occasion of a visit I then paid to the Museum, and I made many anxious enquiries about it from the Curator of the department, who was, however, unable to give me any further information than that it had been in great Britain, some years previous in the collection of a Col. Greville, and that there could be no doubt of its genuineness. On this I went to my friend, the late William Tindall, who was like myself struck with the importance of the matter, and after another visit to the Museum and joint inspection of the specimen, we put ourselves in

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communication with the late Minister for the time being, and were by him referred to the Commissioners of Land and Emigration, for full information as to the terms on which the anthracite mines, if discoverable, could be worked.

We accordingly requested an interview, and after about a week's delay, this was accorded, and we were received by a gentleman whose name I forget, but who represented himself as the organ of the said Commissioners. Our enquiry had been "on what terms would H. M. Government dispose of the right of working anthracite, if we could find the same in remunerative quantity?" The answer was explicit though any thing but satisfactory. We were informed that the Commissioners would not sanction the sale in the right of working minerals *on any terms*, but that they would lease any mines we might discover for a limited number of years, on payment of a royalty. Of course we pointed out that it was perfectly preposterous to expect that any capitalist would sink money in machinery, roads, the exportation of miners, &c., if he were merely to have a brief lease of the mines on which his money was expended, but our words were wasted. Her Majesty's Commissioners had decided the point without even seeing us, and there was an end of the matter.

I need hardly say that this intimation was in itself sufficient to annihilate all wish on our part to have anything to do with mining in Ceylon. Before leaving, however, we felt bound to press the point "what would be the extent of the royalty demanded"? a question which our official friend eluded like an eel, till being at length brought into a corner, he graciously intimated that he did not think it would exceed forty per cent? On this, Mr. Tindall told him he should think no more of the matter, and the interview terminated.

It was just one of the many instances constantly occurring in which excessive greed defeats its own object. Any person who new the late Mr. William Tindall, knows that he was not a man to do things by halves. Had he been met in a fair spirit, he would have sent out a mineralogist to Ceylon, he would have purchased the anthracite mines, if discoverable, and possibly at this day, Ceylon would have had not only smelting furnaces but a railway.

Let us hope that our present Government is wiser in such matters than its predecessors, and that instead of thus throwing difficulties in the way of discovery and enterprise, they will afford every reasonable facility.

Your obedient servant,
JOHN ARMITAGE.

MINERAL RESOURCES OF CEYLON.

Our notice of anthracite in our last has brought us a letter from Mr. J. Armitage, which is worthy of attention, as shewing how private enterprise, on which the progress of countries and people depends, can be stifled by the influence of mere red-tape-ism. A change has come over the spirit of English Statesmen since then, however. Sir John Packington conceded, and the Duke of Newcastle confirmed, to the Australian Colonists, the right to make the best they could of their mineral wealth; and altogether we believe the spirit in England now is so different, that any official acting as the agent of the Land Commissioners did in 1846 would get him to relieve Government of his obstructive presence. We believe the Home Government would support the local one in offering a thousand pounds reward to anyone who would discover a workable anthracite mine in the neighbourhood of the "millions of tons of iron in Saffragam." Such a discovery would be of incalculable importance at present. We should soon have a railway from Colombo to Galle via the iron and coal works of Saffragam, conveying coal to the steamers and iron sleepers for the railways of India. Such a consummation would be of far more importance to Ceylon than even a successful issue

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to the search for gold—an issue which, we are fast coming to the conclusion, we have little right to expect. Gold dust we have, but there is as yet no established discovery of nuggets. The bit of gold forwarded to Mr. Power as mentoined in our last, was from Dambedeniya, in the olden times the capital of the Maya division, the seat of Royalty and of a Mint. On page 243 of Davy's work will be found an engraving representing the figures on the Dambadeniya Rhatra (gold) and the Dambadeniya chally, (copper). Justice Starke, in a paper on Numismatics, in the transactions of the Asiatic Society, states that in Davy's Work the reverse is turned upside down, and that the characters which Davy described as resembling hieroglyphics, really represented the monkey chief Hanuman, with Vishnu on the obverse. Now looking at the hoarding propensities of our Kandyan brethren and at Dr. Ellery's report that the bit of gold was entirely without alloy, we strongly suspect that this was just an old piece of Rana's or Demon's money knocked up into a convenient shape. The search for gold will bring such things forth without any intention to deceive; but the specimen from Nuwara Eliya is far more suspicious. Mr. Sterling has declared it to be alloyed with copper in a proportion which is never seen in *nature*, but which exactly tallies with that of the jeweller's gold in Ceylon. Dr. Kelaart, however, appears to have found a few grains of gold on the Plain, and, notwithstanding the rather off-hand decision of his friend Hopkins, the Geological Doctor is not without hopes that the diggers may "fall into" a pocket of gold. If they do, we suppose, they will say as the Irishman did when he tumbled into a hole full of water of which his friend *meant* to have told him "Never mind, I have found it." Our notice of the red quartz at Mr. Anstruther's property of Hyndford has brought us the information that some time ago a sailor who had made his way thither asked leave to search for gold, and was referred to the Government authorities, after which nothing further was heard of him. Another edition of the anthracite story perhaps—With reference to the controversy respecting the Ophir of Solomon and the ancient Taprobane, we append a couple of extracts which we find in Mr Hardy's *Friend*:—

Ceylon, the Ophir of the Scriptures.

It is probable that the precious metals were obtained by Solomon from the island of Taprobane, so often mentioned by the ancients, which lay but a short distance from the Red Sea and the Arabian Gulf, from which the fleets of Solomon and Hiram sailed. Taprobane is the island of Ceylon. Some writers tell us that it was called by the ancients Simunde, which readily becomes, in their hands, Simande or Sumoende; and finally Sumatra. A celebrated geographer indeed mentions Taprobane under this name; but it is an error of the manuscript, and the reading should be Palæ Simunde. It was thus known to the ancients, and was afterwards called Sales and then Ceylon, from which island Solomon undoubtedly obtained his great riches. The reader may consult on this subject Bochart, who has produced twenty-one particulars, in which the Ceylon of the moderns and Taprobanes of the ancients. It abounds in precious stones and ivory. The only objection to receiving Ceylon as the Ophir of Solomon, is, that it required three years for the fleets of that prince to complete their voyage to Ophir, whereas Ceylon lies at a short distance from the Red Sea. According to Strabo, the ancients, in sailing to this island from the main land, discovered it on the seventh day, but did not reach it until the twentieth.

However this may be, the length of the voyage was occasioned by the miserable equipment of their fleets, which consisted in part of vessels of papyrus. Isaiah observes that the Egyptians despatched "vessels of papyrus" to the maritime cities, to announce that their god Osiris was again found. How could such vessels withstand the violence of the waves or winds to which they would be exposed in a voyage to Ceylon? By papyrus vessels are meant those whose sails were made of papyrus, which was ill-adapted to such a pur-

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pose. Strabo accounts for the length of the voyage to Taprobane, by saying that ships were either bad sailors or had poor sails. The Jews in the time of Solomon were even less experienced in navigation than the Egyptians; and they probably did not venture out of sight of land, but protracted the voyage by coasting along Arabia and India to Ceylon.

Some have thought that the coast of Malabar is the Ophir of the scriptures, because it was called by the ancients Souppara, or as Josephus writes it, Sopheir. We shall not pretend to say whether Malabar or Ceylon is the Ophir of Solomon. These countries are so near each other, that a fleet which visited one of them would naturally touch at the other. Perhaps individuals might have passed over from Malabar to Ceylon, though they did not form any settlement on that island. Benjamin of Tudela relates that he saw a deep abyss in this island, which his interpreter, though a learned man, worshipped as a god. The inhabitants made their children pass through a fire, which was kept always burning, in honour of this deity, who was called Alhauta. They derived this custom more probably from the Canaanites and Tyrians, than from the Jews.

Benjamin assures us that in his travels through India, he met with many of his countrymen, the Jews. He found one hundred in Ceylon, which he describes as producing white pepper and ginger.—*Basmage's History of the Jews.*

Anglo-Saxon Map.

In an Anglo-Saxon map of the 10th century, Ceylon, under the name of Taprobana, is placed as the most eastern part of the world, in size a little larger than Ireland. It is said to have ten cities, and two fruit-seasons in the year.

Arabia, Africa, Continental India, Malacca (where the natives still call the gold mines *Ophirs*), and even Peru, have been set up as rivals to Ceylon in the competition, but probably many of our readers will join Mrs. Fletcher (Miss Jewsberry) in exclaiming:—

Ceylon! Ceylon! 'tis nought to me
How thou wert known or named of old,
As Ophir, or Taprobane,
By Hebrew king, or Grecian bold:—

To me thy spicy-wooded vales,
Thy dusky sons, and jewels bright,
But image forth the far-famed tales—
But seem a new Arabian night.

And when engirdled figures crave,
Heed to thy bosom's dazzling store—
I see Aladdin in his cave;
I follow Sindbad on the shore.

Dr. Gygax's report of 11th January, 1849, is not forthcoming, but a gentleman who took notes of its prominent contents has favoured us with the following Memo:—"Gold.—Traces of it in the iron pyrites of Gettyhedra, which might be worked for its alum, and thus the gold would pay."

Latest Gold Intelligence.

On the 21st Mr. MacCartney reported from Bradley's Diggings that the quantity of Gold found on the previous day was "very much greater" than in any corresponding period; "and one of the specimens nearly as large as half a grain of Rice." On the 22nd (yesterday) it was apprehended that if the rains continued, operations would have to be suspended.

We have seen the nugget forwarded by Mr. Talbot. It is about the size of a small grain of rice—its weight about 2 grains. It was given to that gentleman by a person who is in the habit of visiting Ratnapura in search of precious stones, and who in 1850 received it from one Kirihamy of Kuruwitte Korale. The latter said he had found it at a place called Madol Deniya

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in Weraloowa, about a mile from Ratnapura on the Colombo Road, a canal running up from the place to the river. The person to whom it was handed kept it as a curiosity, shewed it to one or two persons, and produced it to the Agent in reference to the discovery of Gold. He produced two other specimens dug by himself at Delwella, but without being aware whether they contained Gold or not. The Nugget found by Kirihamy did not adhere to any other stone when handed to the present owner, but it had been washed with precious stones in a sieve.

The surface of the soil where the stones are found he describes as black, as on marshy lands, with blue clay or "Kirremettya" [Kaolin] underneath.

THE TWO "TOMS."

It may be as well to correct the impression, should it anywhere exist, that the "Tom" used by the diggers is identical with, or has any relationship to the gentleman who has received the special appointment of Gold Commissioner. The Tom used by the diggers is a *timber* one, which of course renders the supposition the more ridiculous. There is nothing *wooden*, whatever there may be of good metal, in the composition of the Gold Commissioner.

(From the *Ceylon Times.*)

THE MAHA OYA DIGGINGS.

Having been to the scene of the operations of the Seamen late of the "Martin Luther" in the bed of this river in their search for Gold, we now are able to form a better opinion of the matter derived from a careful personal inspection extending over two entire days in a place which both for heat and desolation exactly resembles the lower ravines of the hills which lead the Nerbudda and Taptee Rivers of Guzerat to the plains, or of the gorges and vallies which take the rains off the Ghauts, of the Deccan, all like the Maha Oya affording the same characteristics for gold, both as to geological formation and general appearance.

As to the question of gold in the Maha Oya, there is no doubt whatever on the point, for not only did we see other procure it, but with the aid of a tin pan and a spade which we took from Colombo, we washed some 12 or 15 pans of clay or gravel quartz dug out of the river bed from amongst some large quartz boulders. In four or five of these pans, after careful washing, we found amongst the black sand left after the washing off of the earth-clay, and quartz, from one to two most minute specks of gold of a more vivid yellow tint, which through a lens evidently by their abraded surfaces showed the effects of long travel from the original matrix whence they were washed to the lower parts of the river by the heavy floods of ages.

Independently of the product of our own personal exertions we saw the results of trails by other gentlemen who were also successful in their search, nay one visitor Mr. Anthony Worms of Pussellawa, took a few handsful of the gravel and with Mr. Jones of the same place, carefully washed it, and found what may be called the only nugget which has hitherto been taken from the Maha Oya. This specimen was about the size of a small canary seed, flat on one side, the other being rounded. On Saturday, Bradley and his chums set to work about 8 o'clock in the morning, and with the aid of about 12 or 14 coolies washed from 4 to 500 buckets of earth, and on clearing the trough under the Tom at about 5 p. m. the *residuum* showed about 150 to 190 specks of Gold, the value of which might be 10 shillings. The opinion formed not only by us, but by almost every Englishman present (about 30 in number) during the two days we were there was, that although Gold *was present*, it would not pay for the trouble and outlay necessary for the prosecution of the search; but as a mineralogical search where the outlay of a *few pounds* would produce a *few farthings worth of Gold* in order to

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establish the fact of its presence; the experiment was worth the outlay. Gold there is, but he would be a bold man who either forsook his common avocations in life for a prospect of obtaining a livelihood by gold seeking, or dared the deadly climate of that desolate spot for any time beyond a few days. Fever is already amongst the seven men, three of whom including, the head (Bradley) have been already laid up. The heat in the bed of the river closely shut in by forest to the very edge of the sands, is of that intensity which none but those who have visited the place can have the remotest idea; —a hot breeze setting in afternoon which plays amongst the trees, heating every object even under cover adds additional charms to the lovely locality, whilst here and there are continually seen little whirlwinds of hot air, spinning round and round taking up in their gyrations columns of dust and dead leaves.

We will now give a slight description of the place and its locality.

On arriving at Ambepussa you can easily obtain coolies both as guider and baggage carriers; leaving the Resthouse at the stables, you turn short to your left and crossing a range of dry paddy fields, you come to a path leading through about 2½ miles of low jungle abounding in quartz rocks and boulders, with here and there spaces which have been cleared by the natives for planting kurakkan grain. Throughout this distance there are two or three native huts, whose inhabitants (if they had any) were not visible. At the end of these 2½ miles you descend a bank about 20 feet declivity to the bed of the Maha Oya, at this season presenting a flat surface of sand and small pools of water here and there, the breadth of the expanse being from 150 to 350 feet; having at the present time about sufficient running water to turn a few water mills. Wading through these pools for about a mile, you reach what are called the "diggings." On the left Bank—looking *upwards* to the source of the river—you perceive a clearing—lately burnt off—of about 12 or 13 acres bought by Mr. John Selby—on which is erected the Talipot covered house occupied by Mr. Power the "Gold Commissioner,"—close to this nearer to the river bed is a talipot shed put up by the Resthouse-keeper of Ambepussa, at which weary gold seekers may procure refreshments at—for the place—really moderate rates. On the opposite side of the river are a half a dozen huts, put up by the Police about 30 in number and by the Diggers themselves.

The scene of operations is in the bed of the river. In the centre of the almost dry bed, is a small rocky island which the natives say was cut off the main land by a heavy flood in 1838;—the hole, out of which the seamen and others wash the deposit is at the upper portion of the island which divides the stream into two parts during the monsoon—at present both channels are nearly dry. The depth of the deposit is from two to three feet to the solid bed rock and the "Tom" which we have already described is within about 20 feet of the hole from which we should think up to Saturday about from 7 to 10 tons of "stuff" have been washed from first to last by the diggers and visitors. The extent of the deposit is about 300 feet long by 70 broad, and its removal to the "Tom" would, if the diggers worked 8 hours a day, occupy some five or six months to remove. We had not time to travel the river downwards from the excavation to any extent; but for the mile above it we saw no alluvial products, nothing but a bare expanse of sand with here and there a few ridges and slabs of quartz rock.

Above the "Tom" some 200 feet, a dam has been constructed by a gang of labourers at the charge of Government, but as the water could not—except at a heavy expense be raised to within 17 inches of the "Tom," it has been allowed to remain in *statu quo*, and a forcing and lifting pump (which our readers will see, we recommended in our last issue long before we saw the locality) indented for on the Commissariat. This, with the aid of two or three coolies, will supply the washing machine with a constant stream of water.

With regard to the nuggets said to have been handed to the "Gold Commissioner," we may remark that we saw them both, one was evidently a piece of "manufactured gold" cut off a little strip of the same metal with a sharp

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chisel; the other certainly bore the impress of being pure, it had originally been about the size of a common pea, but it had had two portions of it cut off leaving the fragment flattened on both sides. The other nugget alluded to by the *Observer* as having been sent for from about 8 miles distance by Mr. Power, did not arrive but we saw an influential native, the Basnaike Nilame of Katugampola, a place about 8 gowas or 32 miles to the Westward of the Maha Oya; an old respectable chief, who told us that there was no gold in this district, nor had he ever heard of any being found, and other natives concurred in saying that they feared there was no hope of any but small bits being found. Both Mr. MacCartney and Mr. Power are doing their best to elicit the best information as to the existence of Gold as likely to afford a remuneration for the expense of search, but we do not think up to the present time either they or any who have enquired into the matter have any sanguine hope that any digging in the Maha Oya or the surrounding districts will afford any but the most infinitessimal quantities of Gold.

Mr. Power, having a "roving Commission" and properly so—has set off with Bradley for a search higher up the river either at Mahwanelle, or Gordon's Bridge towards the hills. Mr. John Selby also accompanied him, and we may expect the result of Mr. Power's observations in the course of two or three days.

The sum total of our observations is this—the Gold *is* in certain localities in the Island—that it is both the duty and interest of Government, to ascertain additional facts by issuing orders to every Government Agent in the interior to expend a sum of money in the exploration of the different stream beds and vallies of the Island. That the result of the researches may end in nothing is probable, but as small portions of Gold have been found there is no reason to ignore the possibility of finding gold in localities nearer the hill ranges in quantities which may induce extended search which may possibly be a source of profit to speculators. But so far as we have yet seen if the prospectors find no more than has hitherto been seen the whole thing will prove a "delusion."

Much amusement has been produced by the issue of licenses by Government, who have yet to "catch their hare" before preparing it for the spit: they should rather encourage every attempt to find out the hidden treasures of the soil of the Island and it would then be time enough to "put the screw on" when they had ascertained the fact of the existence of gold enough to pay the expense of a 10 shilling license. Just now not a man would purchase one. We shall look with anxiety for the results of the exploration of Mr. Power which will we believe settle the question of the existence of gold in large quantities in the Colony. At present the matter is a perfect problem on the solution of which depends most important changes. It is, we believe, an ascertained fact that Mr. Talbot, the Government Agent of the Southern Province, has forwarded to the Colonial Secretary a small fragment or nugget of gold found at Ratnapura, it is about the size of a seed of the sweet pea, and from what we hear appears to be a *bona fide* production of the soil and which has never been in the goldsmith's crucible. We must conclude our remarks today by referring our readers to extracts on the Gold Question taken from the columns of the "Examiner" and *Observer*.

The whole question is still as far off solution as ever, and our opinions as to the improbability of finding gold to pay the outlay required in collecting it remain as unchanged as ever.

P. S.—3 p.m. Since writing we have just heard from the "Diggings" in date yesterday. Other visitors have made their appearance there and one writes us that he does not think much of the appearance of things at this "fashionable watering place." The diggers still find gold but "very little of it."

On parting remarks we may make, which is that as a large body of Police are at the Maha Oya, and a Detachment of Rifles are under orders for the same locality, it would be just as well if Government allowed them additional subsistence money. There is nothing to be obtained in the desolate hole itself, and prices of all kinds of provisions are exorbitant. At the same time we may add that the services of a Medical man will also be necessary, for we have no

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doubt fifty per cent of those sent there will be prostrate in the fortnight hence.

Through the kindness of the Colonial Secretary we are enabled to announce the following:—

"Mr. MacCartney has been left in charge, Mr. T. Power having left the spot for further exploration, everything was going on quietly and the party at work were continuing to find gold in small quantities; no applications had been made for licenses."

(From the Ceylon "Examiner.")

THE GOLD DISCOVERY.

In answer to an application for the loan of Mr. Hopkin's pamphlet, Dr. Kelaart has sent us the following letter which will be read with interest at the present moment. He informs us that "large pieces of gold" are reputed "to have been found in the Galle district." We shall not indeed be surprised to hear of gold being found in considerable quantities in various parts of Ceylon. Its formations are those of auriferous districts. Only the other day a friend told us that in an elephant shooting excursion he came upon quartz rocks which he felt sure abounded in gold. It is a well known fact that the quartz composing the Ural mountains contains gold in sufficient quantities to pay for being pounded. A personal inspection by Mr. Hopkins of the geological features of the Island would have been peculiarly valuable just now—and we shall be glad to hear the result of Dr. Kelaart's upland trip.

My Dear Sir,—As I intend to examine Bradley's diggings when an opportunity offers, and report upon its geological characters in conneetion with my friend Mr. Hopkins' views on the gold mines of other countries, I therefore beg to be excused sending you the pamphlet for the present, especially as the publication of any portion of it at this moment without a geological chart of the Ceylon diggings will only disappoint your readers, or discourage the gold seekers in Ceylon. Let them go on as they have begun and success may still attend their labours.

I can, however, inform you that on Mr. Hopins being told that a few grains of gold were found some years ago in Nuwara Eliya, he bade me not be too sanguine as to finding the precious metal in any large quantities in Ceylon; for although, gold is diffused throughout nearly all the primitive rocks in the world, the characters of the Ceylon primitive rocks are not such as hold out promises of very productive fields of gold, but that there is every reason to believe that gold is to be found in Ceylon in the same "small" proportion as in some of the primitive rocks of Southern India. And, it is quite possible that Bradley and his companions may fall into some localities where there are "pockets" of gold, the accumulation of ages, the debris of worn down granitic rocks.

It is a pity that Government should have stopped (at this early period), digging in other parts of the Island. I have every reason to believe that hard-working men with a few practical lessons from Messrs. Bradley & Co., will succeed in finding gold in the same small quantities as at Ambepussa in various parts of the Island. The valleys of Dimbula, and Saffragam, Kotmalie, &c., must be as auriferous as the banks of the Maha Oya.

I shall be agreeably surprised to hear that nuggets of gold are found in this Island. The geological character of Ceylon (as known to me) do not hold out any such rich golden prospects. However, it is only by examination of the course of the Maha Oya and its rocky bed that the geologist, or the practical mineralogist, will be able to speak positively on such a valuable subject as this.

As Mr. Hopkins was for some weeks in Galle, he would have gone up at my suggestion to examine the geology of the mountainous districts of the Island, but that he did not think it worth the expense of travelling, as the

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same species of rocks as cap the heights of Pedrutalagala and other mountains are found, a few feet above the sea's level, in and about Point de Galle. The "Felspathic" granite, in which gold in fine grain is so abundantly found in Australia, is the kind of rock on which the fort and town of Galle, are built. The clays also which abound in the neighbourhood of Galle, even below the sea's level. Micose and talcose schists, border the beds of rivers and canals. So that an eminent mining engineer like Mr. Hopkins has now sufficient data to appreciate the golden dreams of Ceylon. By the last mail he was informed of "Bradley's diggings," and therefore, as he was the geologist consulted by Government on the discovery of gold in Victoria he will doubtless be referred to by the Colonial Office for information regarding Ceylon. It was his particular wish that I should keep him informed in all matters connected with future Ceylon diggings, which he thought would soon be heard of from the number of Australian diggers finding their way to Ceylon. I can only regret that I cannot immediately make an inspection of the diggings to find out if there is any new feature in the geology of the district hitherto unknown to the geologist, and I think I may point out to Bradley and his friends some of the likely sites of gold-bearing rocks "in situ," from the additional knowledge I have acquired from Mr. Hopkins since my last visit to the Highlands of Ceylon.—Believe me, yours truly,

Point de Galle, 17th March, 1854. E. F. KELAART.

P. S.—For the information of some of your readers I may as well inform you that Mr. Evan Hopkins, is the geologist and engineer of the Victoria Gold Company and was for 9 or 10 years the director of the largest Peruvian gold and silver mines. He is also the author of the work on the Electro Polar, or magnetic formation of primitive rocks, which upsets the doctrine of igneous formation. The mining journal in reviewing Mr. Hopkins' system of geology observes that "owing to its practical application to mining, and the satisfactory manner in which it accounts for all phenomena connected with terrestrial physics it is becoming an established system with practical men. The interest has been considerably enhanced of late, owing to the recent discoveries made by the indefatigable Dr. Farraday, corroborating in a remarkable degree, Mr. Hopkins' views, as explained in his works."

Another reviewer says "that the igneous theory, the doctrine of central fire, has for some time been slowly yielding to other views. All the phenomena attributed to fire may be produced (according to Mr. Hopkins' system) by electro-magnetic currents. It is difficult to imagine the existence of fires unsupplied with the oxygen of the atmosphere."

To this I may add that since I have applied Mr. Hopkins' views to the geological structure of the primitive rocks of Ceylon I have less faith in the doctrine of the igneous formation.

THE (GOLD?) DIGGINGS.

(From the *Ceylon Times* March 24.)

We have letters from this place, both of the 21st and 22nd instant, which fully confirm our former opinions that gold-finding to pay will prove an utter failure. On the 21st we find that two of the finest specimens were found much finer than that dug by Mr. Anthony Worms a few days since, but the result was utterly unremunerative.

On the 22nd not a soul in the shape of an Englishman made his appearance; heavy rains had fallen and the men had ceased to work, and if the rain continues, there is no doubt they must shut up "spades and picks" and again plough the "sounding main" in place of digging the bed of the Maha Oya;—indeed we have heard that two of them have already returned and shipped themselves on board the "Lady Sandys," and a week hence we shall expect to hear of the total abandonment of the whole thing.

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The result of the exploration of the 21st was 6 spangles of gold as large as a small canary seed, three of them being a little larger, so that probably the whole find of Bradley and his fellows, from 6th of the month to the present time, has not amounted to 15 shillings.

Heavy rains with violent thunder had commenced, and the next accounts will bring intelligence of the sweeping away of the dam if it has not already gone. The Police we hear had killed a small crocodile, in their hut which showed fight, never once attempting to run from the blows inflicted. We hear that the whole are sadly disgusted and we may expect a week hence to hear that "Bradley's diggings" have resolved into their primeval solitude, tenanted only by the alligator of the river and the wood-pecker of the forests of this miserable and deadly hole. We speak feelingly, for we are compelled to curtail our remarks in to-day's issue from an attack of fever, the result of too much exposure whilst prospecting for gold in a midday sun in the delectable locality. So far as we hear, the best thing is to order all the Police there to forsake the place at once; the farce of keeping 30 or 40 men with officers, to look after a *challie's* worth of gold is too palpable an absurdity to be persisted in for a day longer.

We repeat that there is not gold enough to be found to pay for the sustenance of a mosquito, and the curtain should be allowed to descend on the whole farce at once.

Latest from the Gold Explorers.

We are told that Mr. Power, Dr. Ellery and the Seaman Bradley, who went to the Maha Oya Diggings, and left that place on the 19th instant in prosecution of further search to the north-east of the river, have made further discoveries of auriferous earth in the bed of one of the tributaries of that river, called the "Hingool Oya," giving a name to that valley, through which was to have run a portion of the Railway to Kandy, which, under the auspices of Lord Torrington would ere this time have been in full work giving a most ample return for outlay. This river runs to the south-west under a wooden erection at the foot of the ascent of the Kadugannawa Pass, called Gordon's Bridge across the Kandy road between the 58th and 59th mile-stones.

Tracing the Maha Oya upwards at the village of Attapitiya, at about 40 miles above the original station, they again found auriferous earth; the specks very small, but existing in every pan of earth washed. The above report is of so early a date as Tuesday last, but the delay in its receipt, was owing to its having been sent to Kandy en route to Colombo.

We have had no further report from Nuwara Eliya, but from indirect sources we hear that the search has been unproductive of Gold.

Altogether we much fear the outgoing Mail of to-morrow will take but a "Flemish account" of the far-famed Gold discoveries in Ceylon.

(From the *Colombo Observer*, March 25th, 1854.)

Postscript.

Mr. MacCartney reports in a letter of yesterday's date that the rains had put a stop to the digging operations, but that Bradley and his party still retained their good opinion of Ceylon as a Gold country. Bradley has returned to Ambepussa from his "prospecting" tour with Mr. Power, suffering from fever. Temporary assistance had been asked from Government, but no reward is looked for until profitable Gold diggings are discovered.

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(From the *Colombo Observer*, March 27th, 1854.)

MR. HOPKINS' PAMPHLET.

We have seen a copy of the pamphlet so mysteriously alluded to by Dr. Kelaart and are by no means inclined to cry out "Eureka!" The writer has a theory which he embodied in a big book, and the object of the smaller one published at Melbourne seems to be chiefly to draw attention to this theory and to support it. The theory is a very pretty one with doubtless much of truth in it, and it appears to have been found practically valuable. It is no new discovery that crystallization obeys certain fixed geometrical laws, nor is the idea novel that magnetism is the principal agent at work in giving to minerals their distinctive shapes. Mr. Hopkins merely goes a little further than others in a certain direction; explaining by reference to his own theory what others have attributed to ignious agencies of which he pretends to see as little in the great mountain ranges which intersect the globe as in the scattered deposits of metals and minerals found within their bosoms or lying at their bases. "Terrestrial Magnetism, the polarity of matter and the meridional structure of the crystalline rocks" are the catch words of his geological faith. His main principle is that "Nothing can destroy the active and reproductive principles of the mineral kingdom. In the deep recesses of the crystalline film the subtle power of polarity is present, constantly permeating beneath the scene of vegetable and animal life, and a never-ending process is going on, giving form to mineral matter in all its variety, from the formation of a crystal to the aggregation of crystals which constitute a Continent."

He must be a man after Mr. Simms' own heart. He dwells with horror on the variations of the needle which may put the boundaries of a survey out *in a few years*, and he agrees with our Surveyor-General that great base lines and trigonometry should be at the foundation of all surveys. But neither those who dig for grains of gold or to produce "Golden Grain" can wait to study trigonometry or to start from base lines. We sympathize with Mr. Hopkins however in his preference for water and there is no denying the composing power which he attributes to felspar. We see it daily converting our granitic gneiss into useful cabook and good soil, while even the glass-like quartz, affected by the same subtle agency, is forced to yield up the wealth of gems or metals which its maternal bosom encloses. Felspathic rocks are the richest in minerals and the rocks of Ceylon are highly felspathic —that is a fact indisputable: and if we have not large deposits of gold now, they will *grow* with the lapse of ages and for the use of future generations. Posterity has certainly done nothing for us, and yet we can rejoice at its good prospects. Here we have still stronger proofs that the root and twig-like gold of the Mahawanso was a substantial verity, for Mr. Hopkins is decidedly of opinion that the roots of trees and even grasses exercise a decided influence on gold in the process of formation. The roots of large trees should, therefore, be searched in the neighbourhood of the Maha Oya and other Diggings. One of the tales that delighted the childhood of most of us was the discovery of the silver mines of Peru by the accident of an Indian grasping and uprooting a shrub to save himself from falling, the discoverer enriching himself before he revealed the secret. Mr. Hopkins has seen gold formed in the shapes of ferns or corals, and deposited in old mines on leaves of trees. A long account of the supposed process is given, tending to this principle, that "carbonate of soda is a most important substance to sprinkle in a poor soil to liberate the elements of the crystalline rocks to feed the roots of plants: the required nourishment is thus absorbed from the soil, and the metals and other ingredients rejected by the roots are left behind like indigestible substance. The roots of trees take up the potash and leave the gold behind. In the same manner [?] the ferruginous rocks forming red caps on hills by the decomposition of the iron, are favourable for the liberation and development of the gold, contained in auriferous slates. Hence the red hills are favourable localities to the gold digger." We are

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thankful to learn that gold is never mineralized—that though often found mechanically connected with iron pyrites it is always metallic. It is improper therefore to say, as we have all been saying, "gold ores or minerals." Mr. Hopkins who has had much mining experience states that auriferous pyrites in the Andes containing from 5 dwts. to 3 ozs. per ton are pounded and washed. From the decomposing mass several *crops* of gold are ultimately obtained. In alluvial deposits, such as those in the Maha Oya and on its banks, "the favourable productive parts are necessarily found at the points presenting the greatest resistance to the streams, such as ledges of rocks, boulders, hollows in the bed and bends in the channel." These principles seem to have been observed in the choice of Bradley's diggings. The following principle, however, if correct seems to point out what the nature of our Ceylon diggings must be:—"the gold produced from felspathic granite, in the absence of slate, is of fine grain." Just so: we have no slate but plenty of felspathic gneiss—our gold is fine. Were it found abundantly and on large proportion per ton of earth, this would not matter: but this is the point at issue and it is of great importance that it should be decided. If the original band of Diggers are not all placed *hors de combat* by the malarious climate of the Maha Oya, the interval between the March rains and those of the regular S. W. Monsoon would be the best possible time for an extended and thorough search.

The Gold Question.

Our notice of Mr. Craig's discoveries in Saffragam has brought us the following letter which corrects some misapprehensions on our part. We think it a great pity however that Mr. Craig should leave the Island with any degree of uncertainty hanging over the alleged discovery of copper. Some of the richest and most valuable ores are found of "the true copper colour," although green is the general hue.

Galle, March 24th, 1854.

Dear Sirs,—I have just persued your issue of the 20th inst.—and on the subject of Gold in which you mention my name, allow me to inform you *the substance* I discovered while tracing a road in Saffragam was not shewn to Dr. Lamprey—and it needed to examination; it contained as you say copper—with the usual copper colour.

The substance given to Dr. Lamprey by me, was found near the road from Avisawelle to Karoen Ella (on the banks of the latter) and with regard to which you state "a further examination, &c., is said to have led to the detection of Gold in Mr. Craig's specimen." Now allow me to say that I gave you this information from having heard from good authority that Dr. Lamprey had forwarded or was about to forward a paper to the Asiatic Society stating that he had discovered Gold in a specimen that had been found somewhere near "Ruanwella." Now as Karoen Ella, or the place where the substance was found that I gave Dr. Lamprey, is within 2 miles of Ruanwella, I considered that it might possibly be *the* specimen I furnished him with and such I believe was the information I gave you—and as it was only on supposition I beg an insertion of this in your next.—I remain, dear sirs, yours faithfuly,

Robt. Craig.

We regret to learn that Mr. MacCartney, the Superintendent of Police has returned to Colombo suffering severely from fever. It is said that Major Skinner has been ordered from Badulla to form a road from Ambepusse to the diggings.

Mr. Simms, with a staff of Surveyors, has also been ordered to the locality, so that we hope the public will soon be in possession of a map affording some further information than that recently given to the world where the 'Property of J. Selby Esq.," occupies so conspicuous a place.

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The purport of Dr. Ellery's report we believe to be that from near Ambepusse to the diggings the Maha Oya flows slowly over water-worn gneiss with occasional masses of smooth quartz. The diggings are situated where the river takes a sudden bend from a south-westerly to a north-westerly course. Here, there is a large "diluvial" deposit of smooth gneiss, quartz boulders, sand and gravel cemented together by a reddish clay. The gold was distributed throughout the mass, but was most abundant in the deeper parts and in the rock crevices. The drift seemed to have come from a distance. The gold is either in scales or small rounded masses, much water-worn. On proceeding 40 miles towards the source of the stream Gold was found in the tributary Hingool Oya, near Gordon's Bridge between the 58th and 59th mile stones on the Kandy road. The Geological formation seems much the same throughout—large detached masses of gneiss with quartz pebbles. Dr. Ellery describes it as resembling in its general and particular features many of the gold yielding tracts of Australia, and he is of opinion that by the aid of proper machinery and deep digging the results might be remunerative. On the Maha Oya itself gold was found at Attapitiya, 2½ miles from Gordon's Bridge, at Deyanella, 6 miles farther up and at Nartakanda coffee estate 3 more miles towards the source. Mr. Power corroborates Dr. Ellery's report and supports his opinion that deep digging and careful washing would yield profitable results. He reposes confidence in Bradley, who with his Californian and Australian experience declared that gold abounded in the region traversed by the prospecting party.

(From the *Examiner.*)

The following is the result of personal remark and information forwarded by others.

At *Bradley's Diggings.*—Yattalgodde on the Maha Oya, the dam after being erected was found useless—the distance required (270 feet) being too much for the hose. A forcing and driving pump has been sent for, and it is expected that it will enable the diggers to work continuously. That party has been greatly reduced during the past few days, Bradley and another having been absent prospecting with the Gold Commissioner—and another having been sent away sick to Colombo under charge of a comrade. As has been before remarked the gold found appeared generally to increase in size according to the depth dug and this was further confirmed by the finding on Saturday last of a piece of rather more than 2½ grs. in weight. This was taken out by a gentleman who having noticed the similarity of the rocks at *Bradley's Diggings* and in the Mahaweliganga and Kotmalie Oya both of which streams run through his properties intends to prospect forthwith. Having noticed in our former report that a native had found Gold, and sold part of it to Mr. Jayatilake Mudaliyar of Kurunegala, we were glad to see a piece of the same gold, which was brought from the village by orders of the Commissioner and having been tested by Dr. Ellery of Kandy was pronounced to be *pure gold.* The rocks about Yattalgodde are generally of gneiss with large quantities of mica and layers or strata of broken quartz both pink and white. But a little higher up the river this is completely altered. There you find the gneiss rock abounding in mica and garnet in layers or strata, with well defined quartz veins running through the whole mass in every possible direction; sometimes *at right angles to the strata*, everywhere in short where a fissure has enabled it to penetrate. Proceeding higher up the river small tributaries are found draining the adjacent hills and supplying part of the auriferous deposit of the Maha Oya one of the principal of these is the *Hingol Oya*—it rises in the Kadugannawa mountains and draining all that part of the country falls into the Maha Oya just below Hingolla—a village to which it gives its name. The Kandy road crosses this stream at Gordon's Bridge and as it was of importance to ascertain whether the tributaries supplied their share—the diggers prospected about 20 yards above

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Gordon's Bridge and the result was satisfactory—Gold was found in the same minute "specks" as found at first at Yattalgodde. Proceeding higher up and touching the main stream again at Fort King washing was recommenced and with the same result. Gold was again found. Above Fort King for some two miles the traveller passes over a vein of granitic gneiss with little or no quartz in it; but at Deyenwelle he again finds it. The experiment was repeated there and with success. Pushing onwards the river was searched at Nartakanda Estate in Dolosbage (having now passed the boundary of Four Korles) immediately below the magnificent watefall and again the presence of gold was detected—and thus in all the five places reached, 4 in the Maha Oya itself; the highest spot at a distance of not less than from 50 to 60 miles from the lowest, and one in a tributary stream, gold was discovered—thus proving that over a great extent of surface the auriferous deposit has taken place. It should be borne in mind that from the shortness of time before the mail would leave, their experiments were necessarily confined to surface-washing and in no instance was a greater depth than from 18 to 20 inches reached; the tools a crowbar and a spade with a common tin basin to wash with. At Nartakanda Estate it was reported that a piece of gold attached to quartz had been found in Upper Dolosbage of the size of a walnut—but our informant, who had handled, had not *tested* it though he said he believed it gold; the precious metal has also we have heard been found at Matale by a Kangany in the service of one of the largest estate proprietors in the Island—that Gentleman at once went to the Diggings to learn the '*modus operandi*' And doubtless he is digging now. Returning via Ambepusse we heard that the yield was about 2 dwts. daily—this with only 3 diggers (2 being as before stated with the Commissioner and 2 gone to Colombo) and with neither bore nor pump, and only surface digging for they have not yet reached a depth of five feet below the surface.

P. S.—Since writing the above we have heard that the quantity of gold increases rapidly as the digging gets deeper, and that three pieces were found in one day larger than the 2½ gr., piece mentioned above.

(From the *Observer*, June 19, 1854.)

GOLD AGAIN.

We have been informed that Bradley and his fellows who have been employed by Mr. John Selby in searching for gold, have at length succeeded in finding the precious metal on a private property at Nuwara Eliya, in nuggets, at a depth of 2½ feet from the surface. Of course we do not ask our readers to believe more than they like of this rumour.

(From the *Observer*, June 29, 1854.)

GOLD.

The Mountain, 22nd June, 1854.

MESSRS. EDITORS,—The sensation caused by the *so-called* gold discovery at Ambepussa has hardly terminated before we are again startled with the intelligence of nuggets being found at Nuwara Eliya, and as you surmised the news is to say the least premature, for from personal enquiry I find the total yield to date is about 40 or 50 specks being the proceeds of a *number* of days' work, and as it is almost necessary to use a microscope to make them perceptible, you may be assured that it is a matter of difficulty to ascertain their probable value; but if we *can* rely upon the opinion entertained by the diggers themselves, the days for coffee growing are numbered, as they anticipated finding a mine of wealth in the Nuwara Eliya plains, and this does not seem improbable if we bear in mind the fact, that these men are devoting their time and labour to an enterprise of which there are great misgivings; but if Government are desirous to develope the mineral resources of the country, they could not do better than

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employ Bradley in charge of a lot of men and persevere in the work they have commenced, and in the meantime your readers may rest satisfied that to the date of this letter there has not been six pence worth of gold found at Nuwara Eliya, although it must be admitted that gold *may* be found there in galore; those who want an insight into the mysteries will be well repaid by a visit to the diggings.—Yours obediently, ALPHA.

(From the *Observer*, July 6, 1854.)

GOLD AT NUWARA ELIYA.

As calculated to interest our readers we take from the *Examiner* portion of an article and from the *Times* part of a letter on the gold discovery at Nuwara Eliya. It seems to be the old story over again—gold, but not in nuggets or in quantity to pay. Happily, however, the prospecting now goes on in a region not necessarily fatal to Europeans.

(From the *Examiner*.)

By Friday afternoon at 3-30 o'clock the shaft had reached a depth of some 36 to 38 feet. The soil penetrated was first thick, black, and peaty-looking—next coarse yellow-clay with sand and stones mixed with it, then very fine pipeclay—afterwards coarse loose gravel and large stones—with a larger pipeclay below—and lastly fine gravel and decomposed rock. The stones found in this layer had evidently been exposed to the action of some rapid current, all being rounded from the smallest to the largest. Although it was not considered that that the shaft was deep enough, it was determined as our Commissioner had to leave the following morning, to try a few pans of soil--and about 4 cwt. were washed. The result was highly satisfactory; a sufficient proportion of gold being produced to pay the working expenses. The gold is very fine and small, and there is no doubt that with the rude appliances used much must have escaped. No *nugget* nor anything in the nature of a *nugget* was found; nor could it have been expected by anyone who saw the nature of the soil from which the 4 cwt. were taken, only the smallest, and lightest portions of so heavy a metal as gold being retained in it. On the request to wash some of it, the diggers at first objected that it would be useless, and it was only done to satisfy those who could not wait for the deeper digging. We shall receive a report in a day or two of the result of deeper sinking which will be immediately published. Gold has been now found in this (Nuwara Eliya) district over an immense extent. It has been found as you enter the plain on Mr. Selby the Queen's Advocate's land, on the side of the hill at the back of Sir A. Buller's, on the low swamp in front of Mr. O'Connor's—at Messrs. Baker's Saw Mills, on the high land close by, on the Moonstone plains where the diggers are now working, and lastly Mr. Baker having learned how to *prospect* from the Diggers, went some three miles lower down on the Badulla road and in every place that he tried found Gold. How much farther it may extend cannot of course at present be known but here is an extent of 6½ miles over which it is known to be spread, and that too so thickly that even an unskilled washer can find it in every pan of surface soil. Mr. Baker has, we believe, ordered a quantity of "Toms" and "Cradles" to be prepared so satisfied is he of the auriferous wealth of the district, and others also are following in the same track, indeed before we left Mr. O'Conner had a "Cradle" at work in which the 4 cwt. of soil we mentioned formerly were washed.

(From the *Times*.)

Nuwara Eliya, July 1st, 1854.

TO THE EDITOR OF THE "CEYLON TIMES."

DEAR SIR,—I send you today a sample of the Nuwara Eliya gold, the result of one pan-full of surface earth that was washed today. Bradley and party were

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hard at work last week sinking a deep hole or shaft, so soon as the bed or primitive rock has been come to the intention is to drift or tunnel due north and south. The place where the present Diggings are going on is the *Moon Stone Plains* at a distance of about half a mile from Nuwara Eliya plains, it is exceedingly strange to see such a medley of things and creatures on this hitherto deserted spot *cooking, eating, drinking, smoking, laughing,* and hard work is the order of the day you can here see the roaming *Irishman,* the cautious Scotchman and the knowing little Englishman all watching for the first big nugget so as to, if possible, get the reward if any from Government. Bradley's expectations are sanguine and indeed the same feelings have seemed to inspire all at Nuwara Eliya. Toms, cradles, pans, &c. are all at work ding-dung, several toms and cradles are to be at work next week, so that matters are beginning to assume a business-like shape. Combined with the gold washing there is a prevailing anxiety after gems, one person has picked up a sapphire worth £20. I would wish to impress on your friends in the planting line that there is no fear of Malabar coolies working for one week at Nuwara Eliya at such work as gold digging really is. I have had 10 years' experience of what the Malabar and Sinhalese character is with regard to enterprise and I can with every degree of confidence assure you that I have never met with a Malabar or Sinhalese who had that amount of pluck, energy and hardyhood which a man requires to work at gold digging and washing more particularly at a temperature like Nuwara Eliya; just fancy a Malabar man from morning to night up to his *as coccygis* in water, working as hard as it would be possible for him to do, so fatiguing was the work I noticed going on last week, there were only two men, Bradley and a little Irishman, who did not lag; so that it is not every European that can even stand it, and the man who does must have his heart in the right place; planters need not therefore apprehend any injury from scarcity of labour, should the Nuwara Eliya diggings become ever so lucrative an occupation. We will say but little as to what will be the end of this infant gold field; one thing is quite certain, that at the present moment a good washer when the weather is as fine as it is now, can from the proportion of gold found in every pan of earth earn from 7s 6d to 10s a day, and I am told that a part of Bradley's gang are to see what can be done in that way next week, so as to keep them in funds.

(From the *Observer*, July 8, 1854.)

The question of gold at Nuwara Eliya (the Mountain Sanatarium of Ceylon) is again being discussed in the papers. In our Supplement will be found a letter which accompanied a respectable specimen of the dust sent to our address by a dweller on the plains; while from our local contemporaries we have taken extracts on the same subject. It seems strange that neither there nor at Ratnapura did we ever hear of gold in connection with deposits of precious stones until European research has proved their simultaneous existence. Did nuggets of any size exist it is difficult to conceive how the gem diggers missed them—although, to be sure, they never affected deep digging. The present operations it is satisfactory to contemplate, are carried on in a climate exceedingly congenial to European life and health, if we except a tendency to dysentery in those who work long in the wet, from which Australia and California equally suffer.

(From *Colombo Observer*, July 10, 1854.)

NUWARA ELIYA DIGGINGS.

To the Editors, "Ceylon Observer,"

GENTLEMEN,—I beg to hand you enclosed a specimen of our Nuwara Eliya gold, the proceeds of one pan of surface earth; there is scarcely a pan of

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earth that is washed on any of the feats that has not the same quantity of gold in it, but at a depth of 40 feet the gold becomes a degree larger, and Bradley and his party think there is no doubt but that nuggets will be found on the primitive or bed rock—they have now a fine shaft sunk of about 40 feet, at the bottom of which there are little streams of water working out of the sides; by careful observation the precious metal can be seen washing out from the land, and from this indication the men at work say there is sure to be a treasure close at hand; the next part of the work will be to drift or tunnel, and in doing so, the north and south directions are the intended course.

With the glaring facts now before us of gold being found *even* in *small quantities*, is it not a reasonable question to ask what do Government intend to do? I most humbly think it is time that his Excellency the Governor had put all doubt at rest by expressing his intention to encourage or discourage the enterprise, as also to say what would be the reward given if gold was found in paying quantities at Nuwara Eliya or its vicinity. By a statement of the Government intentions, a capitalist would be able to judge if it would be worth his while to compete with Bradley for the reward which is now *only supposed* will be given. There is another question, if answered by the *Observer*, would be of infinite benefit to all parties holding property in this island. Would the discovery of gold in large or paying quantities do good or harm to the island generally? *You* may perhaps think any answer to my question just now would be premature, and I would much like to see some discussion on that grand point; however anticipating as I do from reasons I will hereafter mention, that the good to be derived from such a valuable metal being found in quantity would be of universal benefit to all classes of Her Majesty's subjects. I cannot but look on with surprise at the little that has been done by the Government of this island towards investigating completely this pending matter; the men now engaged have not the means left them to go on exploring, and what individual having means within his power would invest it on a speculation, when in doubt as to the intentions of Government? Let any man read his title-deed and the answer is there, *all minerals and gems go to the Crown.* It is supposed that the discovery of gold in this island would affect so much the prospects of its present staple article "Coffee," that the Government fear to interfere, in case there should be a cry out by the proprietors of estates. Surely there are no men amongst that intelligent body who can for one moment conceive the idea that finding gold in large quantities would harm their interest. If any I can from a week's experience of hard digging assure them that there are *not* 10 *out of every thousand* coolies in Ceylon who would stand by the work for one week, indeed it requires a European of no ordinary spirit and endurance to remain at work from day to day for the term of seven days. I think in this opinion the *Examiner's* Commissioner will join. The attraction that gold would cause to coolies being the only reason why proprietors of estates can fear for, being considered as groundless by all who have visited the Nuwara Eliya Diggings, we will now consider the good which would occur to planters by the full development of the hidden treasure.—No. 1, A. Rail-road.—Cheap transport for coffee to Colombo, and to the *railroad terminus*; low freights to England and France, as our imports must increase so must shipping; cheap money as exchange must fall; cheap agency at Colombo, as then merchants will have more competition, and lastly, export duties of all kinds would fall, as our island revenue would increase to so great a degree by imports and *land licences*, that Government could then afford to do so. As to superintendents becoming diggers, which I doubt, many of them could stick at it, I would say to proprietors that there is as *good fish* in the sea as ever was *caught*, more good men could be brought out from home; but to come to one point in particular, may I ask would it not benefit Her Most Gracious Majesty's Exchequer to find gold in large quantities! How therefore can any man suppose that the Government of Ceylon would fear the clamour of one particular class! No more than would a bailiff on any gentleman's

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estate in England disregard his master's interest in the seeking for a gravel pit which would give profit to the man that gave him wages, in order to consider what harm or injury the discovery of the pit *might* do to some individuals with whom he was on terms of regard and friendship. No. No. Sir G. Anderson is too good a servant to his Queen not to come forward with assistance, when it is brought to his notice in a proper manner that such assistance is necessary for the full and complete development of the subjeet. For this end the inhabitants of Nuwara Eliya purpose to send a graceful and respectful Petition to His Excellency the Governor; and, Sirs, your good names have been mentioned as being about the best to represent our interest here, beyond that to which you are ever ready to lend a hand of the people. A small fund has now been established by some persons at Nuwara Eliya to help the *Maha Oya* hero with his grub; but he wants more than grub, and we all want an outlet for the slow stream of water that runs out of Nuwara Eliya Plains, before the flat digging can be gone on with.

I am, Gentlemen, faithfully yours,
SPECTATOR.

Nuwara Eliya, July 4th, 1854.

(From the *Colombo Observer*, August 11, 1854.)

DISCOVERY OF GOLD IN NUGGETS.

The Gold Seekers are persevering in their search at N. Eliya, and deep digging seems really to have produced nuggets.

(From the *Examiner*, August 5.)

The Moon Plains Diggings, Nuwara Eliya.

We have abstained from noticing from time to time as accounts reached us, the progress of these works, as there was no new feature to report—the gold having continued in dust or small grains—now, however, that *nuggets* have been found, we at once put our readers in possession of the fact. Yesterday reports reached Colombo, that on the previous day the bed rock having been reached, five or six nuggets were found in the washing, besides a larger proportion of gold dust than had previously been obtained.

At present the depth reached is but small (about 40 feet), and it was at about the same distance below the surface that the digging ranged in Victoria for a considerable period—now, however, we hear of all the richest diggings in Australia being at a depth of 150, 160, and even 180 feet—and we trust similar results will be obtained here.

GOLD IN SAFFRAGAM.

(From the *Ceylon Observer*, November 2, 1868.)

We have so frequently been deceived in regard to discoveries of gold in Ceylon, that we are inclined to receive all fresh alarms with caution. But certainly the evidence seems to be in favour of real nuggets having been found by a "gemming" party in Saffragam. The pieces which have reached the Kachcheri are from $\frac{1}{8}$ to $\frac{3}{8}$ of an inch in length of various breadths, flattened, and much like specimens from New Zealand. A mass of the weight of half a sovereign tested as true gold has been melted from the nuggets, and is declared to be 22 carats—better than sovereign gold. The friend who sends us this intelligence anticipates "Railway to Ratnapura and to Adam's Peak!" Who can say? If not for gold yet for iron. If there are plenty of such nuggets as have reached Colombo, Ceylon will pass through a new phase, and the steam engine which is on its way out to be used for "gemming" will be the precursor of multitudes. The gem region is just the region where gold might be looked for, and we shall not be surprised if this is a real and great discovery.

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GEMS AND MINERALS.

(From Mr. Saunders' Administration Report on the Sabaragamuwa District for 1869.

There is little to say under this head, but to repeat my opinion, and the same has been held by almost every Assistant Agent for the last 20 years, that a very fair revenue might be derived by licensing diggers on waste lands and in streams. I beg to invite attention to my letter No. 361 of the 5th September 1867, and the connected papers on the subject. About £3,000 worth of gems are said to have been found on private lands during the year, including two very fine cats'-eye priced at about £200 each, but no other stones of remarkable value.

No active steps have been taken in the matter of the "gold" discovery, though the Government Agent forwarded a few of the grains, or rather nuggets, for the inspection of Mr. Brough Smyth, the Minister of Mines at Victoria, and that gentleman reported that he had carefully examined them, and was of opinion that they had not travelled far, and that a careful search in the neighbourhood would probably be repaid.

Owing to the sudden fall in the price of plumbago, the digging for this mineral has not been so briskly carried on as I had anticipated and hoped. I believe the quality of the plumbago found in this district is very good, but the cost of transport renders it less remunerative to dig here than nearer Colombo or other ports of shipment.

GOLD IN THE SABARAGAMUWA DISTRICT.

(Reports from the Assistant Agent, Mr. Saunders, to the Government.)

Ratnapura, December 1868.

SIR,—I have the honor to report to you that gold has been discovered in Sabaragamuwa, under circumstances which, in my opinion, justify my asking the attention of Government to the matter.

You are aware, Sir, that there are some old gem pits and some untried land (sold to private parties by Government) on the north bank of the Katugas Ella, which flows at the bottom of the garden attached to the Assistant Agent's house. Some of these pits have lately been and are still worked by the jailer at Ratnapura and others. The attention of the diggers or washers has frequently been attracted to pieces of bright metal amongst the dark black sand which they dug up, but for some time this was supposed to be mica, or, as the natives called it diya-rattrang (water gold), curiosity, however, prompted the jailer to collect some of it, wash and smelt it—he brought samples to me for inspection, and I thought it worth while to forward them to you. I wish them now deemed to be submitted with this letter.

On your informing me that the gold when tested was found to be good quality, it became my duty to look into the matter more closely, and for this purpose I made the acquaintance of Mr. William Murray (a gentleman owning coffee estates in Rakwana), who for many years worked in the gold fields at Ballarat and Bendigo, &c., who has thereby a thorough practical knowledge of the proper means to be adopted in searching, digging, and washing for gold. I saw Mr. Murray on Monday, but his business would not allow of his leaving the estate at once, and he was (like myself) somewhat doubtful as to the importance of the discovery, but he very kindly said he would come to Ratnapura when leisure permitted him, and yesterday he ran in for a few hours. We went to the pits, and watched the manner in which the black heavy sand was turned up—some baskets full were washed, dried and sorted—and Mr. Murray expressed himself completely astonished at the result. On viewing the samples which after a few rough washings were in a white bowl, he exclaimed "ah! that's the real stuff, and no mistake if a sample like that was found in a claim at the 'Ovens,' the whole of Ballarat would be prospecting the

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flat." Mr. Murray could hardly conceal his excitement as he conducted his operations, and it is quite clear to me that he at least considers the discovery to be very important. I felt some delicacy in questioning him, or if I may use the expression, in "pumping" him on the subject, as I was unable to tell him what steps the Government would take with regard to the rights of private parties in the event of gold being found in workable quantities, nor was it in my power to tender him, or promise him any remuneration for a detailed report. He was however most obliging in the matter, and expresed his willingness to assist Government in any way in his power. He declares the prospect to be most encouraging, and the discovery to be well worthy of the most thorough investigation. He thinks that these washings are probably from a false bottom, which would account for the smallness of the grain, and that the real bottom is not yet touched. He recommends that one or two shafts should be sunk to try and find a lead—a few "washing boards" (which he described worked at the stream), and the neighbourhood fairly prospected. Until the views of the Government in the event of the discovery becoming important are made known to me, I can take no further steps. I can neither stimulate nor control private searchings, nor can I even reply to enquiries made upon the subject. Two or three points I consider require to be at once decided. Firstly, will the Government put forward any claims to gold found in lands sold at high prices expressly as "gemming lands?" Secondly, what claim will Government assert to gold found in ordinary private lands? Thirdly, what inducements or facilities will Government offer to persons to search for gold on Crown lands and in river beds?

The question of "claims" when gold is found, rules and regulations for working, export duty, &c., &c., may of course be left for consideration, until we are assured that the discovery is complete.

If I may be allowed to make a suggestion, I would ask to be authorized to request Mr. Murray to give the Government a brief report of his visit, with his opinion on the prospects of success and the immediate steps that should be taken to develope the discovery. If he advises measures similar to those already stated, I would recommend that he and the Director of Public Works be associated with me in carrying out the preliminary experiments with authority to spend say £100, and then report the result to Government. I mention the Director of Public Works as a thoroughly practical man, who would probably know where to get and how to apply the skilled labour required to the best advantage. If this officer cannot be spared, the Surveyor-General would perhaps be able to undertake it. Should His Honor the Officer Administering the Government, or you desire further information from me, before taking any steps in the matter, I think it would be well that I should at once wait upon you in Colombo. I may mention that it is my present intention to apply for a month's leave of absence, the 26th instant, to visit Colombo, but my application will be restricted to a few days in December, if the exigencies of the public service demand my attendance at Ratnapura.—I have, &c., (Signed) F. R. Saunders, Assistant Government Agent.

No. 598—B. Ratnapura Kachcheri, Dec. 16, 1868.

SIR,—I have the honor to forward to you copy of a letter addressed to me by Mr. Home stating the terms on which he is prepared to prosecute a search with the view of ascertaining if gold in large quantities exists in Ratnapura.

I think the terms worthy of the attention of Government, and with slight modifications I venture to recommend a favourable consideration of them.

It will be seen that Mr. Home trusts entirely to the liberality of Government as soon as the discovery of a gold reef is made, the Government is to be informed, and Mr. Home is to be rewarded according to the value of his discovery. This is precisely the manner in which the Government of New South Wales treated with Mr. Hargreaves, the discoverer of gold at Bathurst, when

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he announced that he had found gold. But in the present instance, no valuable discovery has as yet been made.

There are indications of gold in the neighbourhood, in fact nearly one ounce of gold dust has already been collected, but careful and steady search is necessary to ascertain beyond a doubt whether or not gold in quantity exists.

I proposed to you in my letter that Government should undertake this preliminary search, but if a private individual comes forward, and in hopes of the reward undertakes the task and risk, I think it would be more advantageous to employ him.

I would suggest that Mr. Home's terms be amended thus:—

That the Government do give to him (and I think to him and his servant only so long as they steadily work) the right to dig and follow up the present lead, he paying a liberal assessment for all damage done and rendering an account of all gold found, and that, as soon as gold in quantity be found, the Government do take over the discovery, paying Mr. Home a liberal reward according to the value of the discovery when ascertained.

It must be evident to anyone that no private individual could undertake to trace a lead or vein of gold to its source through numerous private lands without the aid of Government, and when Mr. Home states that he will either pay the full value of the land through which he may require to pass or merely the damage done by him in digging up the land (at the option of the land owner), I think his proposal is very liberal. It must be borne in mind that supposing private owners of land to have any claim to the gold beneath the surface, Mr. Home's proposal does not affect them, for the instant the gold is found, the Government takes over the discovery, and may allow the land proprietor to pay only a royalty of 5 per cent, whilst on Crown land finders pay 10 per cent. These I believe are the rates of royalty charged in New South Wales, and it is evidently the interest of every proprietor to assist in a search which may lead to the gold being found in or near his land.

I need hardly say that in recommending these proposals I assume that the Government considers the discovery of gold a thing to be desired and encouraged. Certain settlers will, of course be found, from fear that the industrial pursuits of the country may be interfered with, to oppose it, but experience has shewn that the Governor-General of New South Wales was right when he stated that it would have been as futile to attempt to stay gold digging as to stop the tide, and that on no just or sound principle of Government could it be justified.

The evil to be apprehended is uncertainty, and a rush of persons to a field which may turn out valueless. Disappointment would induce recklessness, disorder, and distress, but if it was known that a search was being made, and that its results would be duly proclaimed, public excitement would be kept down and ordinary business be uninterrupted. It seems to me to be our duty to encourage and promote any search that will at once and for ever settle the disputed question, and if it should be that gold in quantity is really found, we ought to be, and I trust we should be found thankfully prepared to take advantage of the wealth which Providence opened up to us.—I have &c., (Signed) F. R, SAUNDERS, Assistant Government Agent.

To the Govt. Agent, Western Province.

Ratnapura, December 11, 1868.

SIR,--I have just returned from visiting the Ratnapura gold field, where the sample was taken from, which I saw at the Kachcheri, the gold I found at Ratnapura appeared the same as what had been found previous to my going there. I believe from the experience I have had in gold mining elsewhere, that gold could be got at Ratnapura in paying quantities, if systematically worked by an experienced miner. I would therefore propose to Government the following:—

That I alone may be allowed to search within a radius of 2 miles from

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the point where the first tracings of gold were discovered for a period of two years, and request that Government take all such private lands as the gold can be traced on to, as for public purposes the necessary assessment being defrayed by me, or that the Government do secure to me the right of digging along and through private lands, until I arrived at the quartz reef, paying compensation for any damage, and in the event of my sticking a payable quartz reef, my reward to be averaged according to its value, I retaining the right of working the same at the rate of royalty or duty claimed by the Government of Victoria.— I have, &c. (Signed) JOHN W. HOME.

F. Saunders, Esq., Assistant Government Agent, Ratnapura.

No. 16. Government Agent's Office, Colombo, January 13, 1869.

SIR,—With reference to your letter No.——of the 16th ultimo, I have the honor to annex for your information Copy of one No. 12, dated the 9th instant, from the Colonial Secretary with its annexure. I have, &c.,

The Assistant Agent, Ratnapura. (Signed) F. R. SAUNDERS.

(*Copies.*)

No. 12. Colonial Secretary's Office, Colombo, January 9, 1869.

SIR,—I have referred to the Queen's Advocate your letter of the 18th ultimo, No. 818, with its enclosure from your Assistant at Ratnapura, relative to a proposal made by Mr. Home to prosecute a search with the view of ascertaining if gold in large quantities exist in Ratnapura.

I am now directed to transmit to you copy of a communication received from the Queen's Advocate in reply to the reference from which you will observe that he is of opinion that the Ordinance No. 2 of 1863 does not empower the Government to take up private lands for the purpose of ascertaining the existence of gold therein.

I am to add that it would be impossible to concede to Mr. Home the exclusive privilege of searching within a radius of two miles, and he must trust to the liberality of the Government to reward him according to the value of his discovery, if gold should be found by him to exist in remunerating quantities. I have, &c., (Signed) J. SWAN, for Colonial Secretary.

The Government Agent, Colombo.

No. 381. Colombo 31st December, 1868.

SIR,—With reference to your letter No. 589 of the 24th inst. I have the honor to state that the Ordinance No. 2 of 1863, which enables the Government to enable the Crown to take possession of private lands for the public uses, does not, in my opinion, authorise the taking of private lands for the purpose of ascertaining the existence of gold therein.

That Ordinance provides for the taking of private land for an ascertained public purpose, such taking being shewn to be "necessary for the public advantage." It is not consistent either with the letter or spirit of that enactment that the Government should deprive a subject of his land for the speculative purpose of ascertaining whether or not gold can be found in it.

I have, &c.. (Signed) R. F. MORGAN.

GOLD IN INDIA AND AUSTRALIA.

(From the *Madras Mail*, March 28, 1881.)

The Government of India in analysing Mr. Brough Smyth's famous report remarked :—" If we omit the altogether exceptional sample from Wright's Level which gave 24½ oz. per ton, and the picked specimens from the same workings which gave 25½ oz. per ton, we get 88 samples, yielding an average of 1 oz. 8 dwts. 22 grs. of gold per ton." That was the result of Mr. Brough Smyth's explorations in the Wynaad over a period of eighteen months. Let us compare these figures with actual mining results in Australia. The actual yield

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from quartz-mines in Queensland was about equal to Mr. Brough Smyth's average specimens in the Wynaad. The average yield in New South Wales for the same year was 1 oz. 5 dwts. 7 grains per ton. There is no lack of rich "specimens" in Australia as in the Wynaad, but experience has taught the Australian miners not to attach too much importance to specimens. The average yield of a mine, over a period of time, is a far more certain indication of the value of land in the neighbourhood for mining purposes. With the above figures before us, we may well ask ourselves what there is to justify the high prices that have been paid for mining lands in Southern India? This is a matter, however, that chiefly concerns speculators in England; if they are satisfied it is not for Indian landholders to complain.

The reports before us contain some useful hints for the managers of the companies that are commencing operations in our midst. The importance of having improved machinery is strongly insisted on. Though the gold-saving appliances in Queensland are acknowledged to be "the most modern and proved obtainable in Australia," yet, we are told, it has been demonstrated by practical assay that as yet, "only about 50 per cent of the gold contained in quartz is obtainable by our appliances. In some few reefs, where the mundic is largely impregnated with sulphides, especially zinc and lead, and nothing like 50 per cent of the gold can be obtained, even when the reverberating furnace is used." Indeed the importance of the proper treatment of tailings, and matter which has passed through the quartz-crushing mills, is becoming universally recognised. The Queensland report avers that one-seventh of the yield of gold in one district had come from the "pyrites works," the owners of which are supposed to have made large profits. It is worthy of remark that the total value of quartz-crushing machinery in Queensland, is put down at £270,000 only, a small sum in comparison with this capital that has already been raised for mining in India. But with this machinery, the yield of quartz-gold in the colony in 1879 was about 190,000 ozs, worth at £3-10s. per oz., about £650,000. The yield from alluvial mines (chiefly worked by Chinese) in the same year, was 98,815 ozs. The total yield of gold for the year was 288, 556 ozs., valued at £ 1,009,946, the number of miners being 3,191 Europeans, and 5,621 Chinese; and the average earnings of each individual miner was £ 114. For the year 1878, the earnings were as low as £74.

From the same official documents, we gather the interesting fact, that the total Australian gold supply from 1851 to 1878 was £240,000,000. And yet gold-mining flags in Australia, though any quantity of auriferous land may be had for £1 an acre. "The want of means to carry on prospecting operations for the discovery of the new gold-fields, and the gradual exhaustion of those easily worked deposits of our known gold-fields, have been the main causes of the decrease in the number of our gold-miners, and until new fields be opened, or the necessary capital and skill for working the deeper or more difficult deposits of our older gold-fields be forthcoming, an increase of our gold-yield can scarcely be expected." Such is the opinion of Mr. Harrie Wood, the experienced Under-Secretary for Mines at Sydney. It is some consolation to reflect that gold-mining in India will not languish for want of capital.

GOLD IN CEYLON.

(From the *Ceylon Observer*, April 7th, 1881.)

The following is Sir Samuel Baker's reference to the first discovery of gold in Ceylon:—

It has hitherto been the opinion of most writers on Ceylon that the precious metals do not exist in the island; and Dr. Davy in his work makes an unqualified assertion to that effect. But from the discoveries recently made, I am of opinion that it exists in *very large* quantities in the mountainous districts of the island. It is amusing to see the positive assertions of a clever man upset by a few uneducated sailors. A few men of the latter class, who

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had been at the gold-diggings both in California and Australia, happened to engage in a ship bound for Colombo. Upon arrival, they obtained leave from the Captain for a stroll on shore, and they took the road towards Kandy, and when about half-way, it struck them, from the appearance of the rocks in the uneven bed of a river, called the Maha Oya, 'that gold must exist in its sands.' They had no geological reason for this opinion; but the river happened to be very like those in California, in which they had been accustomed to find gold. They accordingly set to work with a tin pan to wash the sand, and to the astonishment of everyone in Ceylon, and to the utter confusion of Dr. Davy's opinions, they actually *discovered gold!* The quantity was small; but the men were very sanguine of success, and were making their preparations for working on a more extensive scale, when they were all prostrated by jungle fever; a guardian-spirit of the gold at Ambepusse, which will ever effectually protect it from Europeans.

They all returned to Colombo, and, when convalescent, they proceeded to Nuwara Eliya, naturally concluding that the gold which existed in dust in the rivers below must be washed down from the richer stores of the mountains.

Their first discovery of gold at Nuwara Eliya was on the 14th of June, 1854, on the second day of their search in that locality. This was found in the 'Vale of Rubies.' I had advised them to make their first search in that spot for this reason; that, as the precious stones had there settled in the largest numbers, from their superior gravity, it was natural to conclude that, if gold should exist, it would, from its gravity, be somewhere below the precious stones, or in their vicinity.

From the facility with which it has been discovered, it is impossible to form an opinion as to the quantity or the extent to which it will eventually be developed. It is equally impossible to predict the future discoveries which may be made of other minerals. It is well known that quicksilver was found at Cotta, six miles from Colombo, in the year 1797. It was in small quantities, and was neglected by the Government, and no extended search was prosecuted. The present search for gold may bring to light mineral resources of Ceylon which have hitherto lain hidden.

The minerals proved to exist up to the present time are gold, quick-silver, plumbago, and iron. The two latter are of the finest quality, and in immense abundance. The rocks of Ceylon are primitive, consisting of granite, gneiss, and quartz. Of these the two latter predominate. Dolomite also exists in large quantities up to an elevation of 5,000 feet, but not beyond this height.

CAUSES OF SUCCESS AND FAILURE IN MODERN GOLD-MINING.

(From the *Ceylon Observer*, April 18th, 1881.)

The *Journal of the Society of Arts* for 21st January contains a paper read by Mr. A. G. Lock on the above subject. In opening Mr. Lock stated that the "Stock Exchange Year Book" for 1880, reveals the fact that £2,240,449 of English share capital was invested in so-called "gold-mining" enterprises at the end of 1879. An analysis of this sum shows it to be composed of :—

£871,658	which has never paid a dividend.
362,041	which has paid none for some years past.
110,000	which is paying about 3 per cent.
896,750	which is paying 10-50 per cent.
£2,240,449	

In other words, more than half this large amount is utterly unremunerative.

To this fact, Mr. Lock said, was no doubt due the suspicion with which the enterprise has come to be regarded, whereas, if properly conducted, none was safer or more profitable. The causes that determine the success or failure of an undertaking were stated to be as follows:—

1. The soundness of the constitution of the undertaking.

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2. The presence of gold in the property, and the existence of the ordinary facilities for mining operations.

3. The knowledge of how to extract the gold in the property, and the provision of suitable appliances for the purpose.

Mr. Lock mentioned the several conditions under which gold occurs, viz:—

(1.) In the form of scattered grains and nuggets, in alluvial deposits, having been liberated by natural causes from its original matrix; (2.) In the form of grains and leaves, in mineral veins (principally quartz), still enveloped in its matrix, but not associated with any other metals, and technically known as "free" gold; (3.) In the form of grains, imbedded in and most intimately associated with (not chemically combined with) various other metallic compounds, chiefly sulphides and arsenides, and commonly known by the comprehensive term "pyrites," disseminated throughout veins of quartz or other mineral.

The first class Mr. Lock passed over, as there is less difficulty and making expense in treating it. The process of crushing and stamping was then described, the best forms of stampers and proper order of their drop being detailed, Mr. Lock said:—

I would here direct attention to a class of stamps recently brought into notice, which though requiring certain modifications to fit them for gold ore crushing, yet are decidedly a step in the right direction—I refer to W. Rasche's, of Melbourne, "direct acting" battery, Husband's and Sholl's Pneumatic stamps and Patterson's "Elephant" stamps. They are all based upon one principle: the battery consists of two stamps only, driven at a great speed (150 to 200 blows per minute), and weighing only 2 to 4 cwt. each, their main differences lying in the means adopted for securing the speed. The perfection of stamping, so far as quantity is concerned, would be gained by allowing each stamp in a battery to work independently, and to surround it on all sides by screens. One reason why some of the stamps in Victoria and America crush so much more than others, is, that they have screens both at the back and at the front of the battery. An excellent little stamp for prospecting purposes has been quite lately invented by Dunham. It can be driven by mule or hand-power, and is exceedingly portable; the stamp is surrounded by screens, and consequently, permits the maximum of duty to be reached.

The appliances for arresting the gold (both free and pyritous) rendered separable by the stamping operation were then described, these being divided into the mercury or amalgamation methods and the blanket-tables. Under the first head Mr. Lock said:—

A very effective arrangement of blanket-tables and mercury troughs, adopted by the largest Victorian companies, is as follows:—The material leaving the stamps is led into a trough, having a perforated plate at the bottom to keep back any coarse stuff, by which it is easily distributed; thence it passes into three connected troughs, containing mercury, dropping from the first into the second, and from the second into the third. Each of these troughs, is fitted with a splash-board, which, reaching down to within a certain distance of the bottom compels the falling matter to penetrate the mercury more or less before escaping over the lip of the trough. Each trough has a tap hole on one side, by means of which the amalgam may be drawn off. The whole of the contrivance is under lock and key, which prevents stealing. At the end of the blanket-table, another similar trough is placed, through which the material passes before entering the waste-trough. The amalgam formed in all these troughs is periodically removed.

The causes of success and failure of the blanket-tables were also described, as well as the treatment of the blanket sand by barrel amalgamation. The treatment of the tailings, a matter of considerable trouble, and largely neglected in well-paying mines, was then gone into, it being shown how much gold at present lost might be saved. Mr. Lock then described the operations necessary for separating the ore from the pyrites; in which amalgamation also takes a part.

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Mr. Cosmo Newbery was spoken of as having introduced several improvements in these processes. The paper concluded with some illustrations of failure and success from using unsuitable and suitable appliances respectively. Regarding the latter we quote the following:—

The first and most prominent example is the well-known Port Philip Co., of Victoria, to whose managing director, Mr. Rivett Bland, the science of gold-mining is much indebted. This company has to raise its ore from a depth of 700 to 1,000 ft. During the past 10 years, it has treated 600,531 tons, the average yielded of which was 5 dwt. 13 gr., the extremes being 3 dwt. 23½ gr. in 1873, and 7 dwt. 21 gr. in 1878. The same company has treated 3,592 tons of pyrites, yielding an average of 4 oz. 3 dwt. 17 gr. of gold, when concentrated. The average total cost of treatment has been £3 13s, 7d. a ton: the average profit, £13 5s. Another Australian company, getting part of its ore from surface workings, has profitably crushed 283,550 tons, with an average yield of 2 dwt. 22 gr. Another treated 7,453 tons in seven months, with a return of 2 dwt. 10½ gr., and paid £2,101 10s. profit. Another realises a large profit from a yield of only 1 dwt. 14 gr. per ton of ore crushed. But the most remarkable of all is the Imperial Company, at Ballarat, which has treated 2,100 tons of quartz, affording only 21·99 gr. of gold per ton, with a fair margin of profit on the operation; in other words, it has made money out of material which is only one-tenth part as rich as the non-pyritous material which its neighbours are throwing away.

GOLD IN CEYLON.

(From the *Ceylon Observer*, April 23, 1881.)

It is evident that in the preliminary operations necessary to the development of a gold-mining industry in Ceylon, private enterprise is to do the work with little or no aid from Government. It has been so, to a great extent, in reference to "new products." Vastly different is the relative positions of the Government and private planters in reference to cinchona cultivation, for instance in Java or India and in this island; and in regard to gold, we have the so-called slow and old-fashioned Indian Government at a very early stage indenting on the services of the highest living authority, Mr. Brough Smyth, for an elaborate survey and report of their supposed auriferous region, while as we have stated, the whilom progressive Executive Administration of this island is content to sleep over the business, and to allow the merchants and planters individually to do the best they can to discover whether paying quartz reefs with gold exist in the country. No one can read Mr. Brough Smyth's elaborate report (lying before us as we write), covering 100 folio pages and referring mainly to "the gold mines of the South-Eastern portion of the Wynaad and Carcar Ghaut," without feeling that had Sir Henry Ward or Sir William Gregory administered here in 1879-80, instead of Sir James Longden, an official request for the services of this officer would have been transmitted to Madras long before the general public had begun to look around for the means of securing professional advice for themselves.

The opportunity, however, for timely official action is past; for we learn on good authority that a Colombo mercantile house, Messrs. Alstons, Scott & Co., have already decided to endeavour to secure the aid and advice of Mr. Brough Smyth in reference to some of the hill properties under their charge. As a preliminary operation, blasting for specimens of the the quartz cropping out on Amblakande and other estates in the Dolosbage district is now being carried on, and the resulting specimens will be laid before Mr. Smyth, who, if he considers them favourable, will be asked to visit and report on the district. In other directions practical steps have been taken of much importance. Mr. A. C. Dixon has been sent to the Sabaragamuwa (Rakwana) district on a mission connected with the prospecting for gold as well as gems. It is not unlikely that this enquiry may eventuate in the Ratnapura ("City

of Gems") or Sabaragamuwa Gold and Gems Mining Company, Limited, with a London as well as local directorate; but a good deal will depend on the nature of Mr. Dixon's report. In still another direction, the services of Mr. Harvey, a gold-mining authority, have been utilized during his few days' stay in the island. This gentleman has, we believe, paid a hurried visit to the Kadugannawa, Ambagamuwa and Matale districts previous to his departure to-morrow by the French steamer for Europe. We have not heard the result, but from among the quartz specimens sent to this office, Mr. Harvey, a few days ago, picked out one piece (received from Amabagamuwa) as affording favourable indications of a gold-yielding reef. The sand sent to us from the neighbourhood of Nuwara Eliya also favourably impressed Mr. Harvey, for, if auriferous as it appears to be, it could readily be made to give up 90 per cent of the precious metal contained in it. The specimens of quartz sent to us are, however, far too small for the miner's or geologist's purpose: blocks two feet in length would apparently be more to the purpose than pieces of a few inches in size. In a few days we are likely to have another gold prospector and geologist in the island in Mr. Macdonald Cameron, and we trust he will have an opportunity of visiting the interior of the island and obtaining some idea of our supposed auriferous region. The point now is whether the planters in several of the districts within this region should not take common action to ensure a suitable examination of their country. We have received notes of a meeting held by the "Wynaad Planting and Mining Associations" on the 16th March last which shews how our neighbours over the water act together. We make a few extracts to indicate that our District Associations in some cases—say in Dolosbage, Ambagamuwa, Rakwana, Matale and Rangala—may well add "Mining" to their "Planting" designation and so treat with Government or gold prospectors as they may deem fit on this new subject of enquiry. The Wynaad planters have, it seems, been asking the Government to do more than it bargained for. We read:—

Gold Minings:—Read reply from the Government of India to the Association's request for the services of a Mining Engineer to report on the district of South Wynaad.

The Government are of opinion that enough has been done on their part to develop the new Industry and that it must now be left to private enterprise. —Recorded.

The Government of Ceylon could not well answer our District Associations that they had done enough already to develop the gold-mining enterprise. It is satisfactory, however, to learn that in answer to enquiries already made, our local Executive—if they are not prepared to call for Reports,—are inclined to impose the fewest possible restrictions on the new enterprise in connection with the mining rights of the Crown. In this connection we may quote from Mr. Brough Smyth's report to the Madras Government:—

This is not the place to discuss the manner in which lands should be leased for mining purposes, nor would it be right to offer opinions which might be opposed to the policy of the Government, but it is perhaps proper to suggest that regulations should be framed and published under which persons could make applications—

1st.—For licenses giving the right to "prospect" for gold.

2nd.—For leases of lands containing auriferous rocks.

3rd.—For licenses to take and divert water for mining purposes.

The manner in which lands held under the various tenures should be dealt with, the taxes (if any) to be paid by landholders who grant leases for gold-mining purposes, and the method of assessing mining properties are questions solely for the consideration and final decision of the Government. It is, however, now well ascertained in countries where gold-mining is an established industry, that the fewer impediments placed in the way of mining enterprise and the lighter the exactions, the more certain are the profits to the revenue. The State gains largely indirectly, and, in sacrificing the revenue which might

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be obtained directly by laying imposts on the miner, it encourages him in his labors and leads him to undertake explorations which, if he were heavily taxed he would never contemplate.

At a general meeting of the Nilgiri and Kotergherry Planters' Associations held at Ootacamund on the 31st March last, the following Memorial to the Governor of Madras in reference to Mining Rights was adopted. We extract the portions of interest to us in Ceylon:—

Humbly Sheweth.—That your petitioners are land owners and coffee planters on the Nilgiri Hills and in Wynaad, possessing large tracts of land held under different tenures. That the development of the mining enterprise has led your petitioners to examine their titles, especially with reference to mining rights and having in many cases found that they are pronounced at home to be unsatisfactory and uncertain, your petitioners have determined to represent their grievances to your Excellency's Government, with the earnest prayer that this memorial may receive your Excellency's favourable and very early consideration.

I.—Government Notification, dated 19th October 1880, *re-mining leases.*

The terms laid down in this notification have already been found to be a prohibition of business. Several sales of properties have been hindered by the restrictive terms, thereby causing loss to proprietors, and a complete block to private enterprise. The rule restricting applicants to blocks not exceeding thirty acres is impracticable, considering that the flatness of most of the Indian reefs gives so small an area of stone to be depended upon for the large expenditure of machinery, even if the lode be present under the whole thirty acres of surface. Added to this is the risk of the stone, from such small blocks, being worked out before the great expense attached to the erection of such costly machinery, can be recouped adjoining blocks in the meanwhile being probably allotted to other applicants.

The following conditions, laid down in the notifications, are also rendering the proper development of reefs on Government land impossible:—

Condition 3.—"That within three months from the date of the execution of the lease, not less than five labourers per acre, shall be regularly employed, during the ordinary hours of labour, on *bana fide* mining operations on each block, in such manner as the Government may approve. Returns of the number of labourers employed per diem, shall be sent to the Collector or Commissioner at the expiration of each month."

Condition 4.—"That the lease shall not be sub-let or assigned without the consent of Government being previously obtained."

It has occurred to your petitioners that terms somewhat as follows might be found much more advantageous to Government and tend to the development of the industry by encouraging private enterprise:—

1.—That prospecting grants be given over a considerable area, say one square mile, for a period of at least six months. This will enable the prospector to learn the strike and dip of the reef on the land he has selected, and whether it is continuous, and it will enable him to secure such portions as he may have found of value, without the fear and risk of his losing the reward of his labour, his neighbours taking advantage of his knowledge.

2.—That a mining lease may be given on the whole, or such portion of the area granted for prospecting as the applicant may select within the above stipulated period of six months.

3.—That there be no restrictions regarding employment of labour.

4.—That if an applicant has satisfactorily provided for the working of any block either by transfer to a Company or otherwise, he may be allowed to apply for and to take up another.

II.—Your petitioners would now address your Excellency with reference to land held on *puttah* tenure. From the notification above referred to it appears that the rules and conditions apply only to Government waste lands, hereafter to be taken up and not yet leased to planters, as it is distinctly addressed to 'persons desirous of obtaining permission to mine for gold on Government

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waste lands in the Wynaad or Nilgiris." It is therefore evident that the orders passed in the notification, cannot have reference to any but Government waste lands, and that the position of holders of land on *puttah* tenure has not yet been defined by Government. Your petitioners would urge that inasmuch as the tenure of land held under *puttah* title is of a permanent nature as regards the terms for which the land is held, the Government should, if it is intended to claim any mining rights, specify distinctly the grounds on which they purposed to do so. They submit that as the majority of such lands were held by private individuals prior to the assumption of rights by the British Government it is necessary that Government should show that these lands were formerly held by with some reservation of mining rights. Your petitioners urge that the right to mine or wash for gold, was not withheld even by Jammies, but a tax was imposed on such operations, and that mining was carried on many years ago in Nanjanaad and elsewhere. Your petitioners therefore pray that an order may be passed by Government speedily, distinctly declaring their policy as regards this question and your petitioners beg further to refer your Excellency to a reputed despatch of the Government of India, No. 7, dated 7th September 1879, to the Secretary of State, which your petitioners have been led to understand distinctly says "that, acting under the opinion of legal advisers, it has been determined that the Crown has no prerogative rights over gold-mines outside the Presidency Town."

[III—is on the subject of land escheated.—ED.]

IV.—Your petitioners embrace this opportunity of bringing to the notice of your Excellency the growing needs of the gold district in Wynaad. Telegraphic communication is urgently required, and has already been represented to the Madras Government, but no steps appear to have been taken to meet this great want. It is difficult to form statistics of the probable returns, but there is no doubt it would amply repay the outlay: each company in Devellah (now about sixteen in number) would probably spend at least R100 a month and there would be a large amount of business, apart from the mining enterprise. The odds, your petitioners would also urge, demand the immediate attention of Government. In the transport of heavy machinery to the mines, great difficulty has been experienced, and your petitioners would respectfully request that the roads may be put in thorough order, and bridges strengthened between Ootacamund and Neddiwuttum, thence to Devallah and Beypore *via* the Carcoor Ghaut.

V.—In view of the rapid extension of the gold mining industry during the past year, your petitioners would respectfully request that a Gold Commissioner be appointed to secure practical and uniform policy as regards gold mining generally.

On the gold prospects in Southern India generally, it may be remembered that Mr. Brough Smyth summarized his views as follows:—

I hope I have expressed with sufficient distinctness the opinion I entertain respecting the gold fields of South-east Wynaad.

The facts will speak more strongly than words to those acquainted with gold mines. Gold has been found on the south near Eddacurra and on the north near Nellacottah, on the west near Vyteri, and on the east as far as Bolingbroke, that is to say, over an area of more than 500 square miles.

The reefs are very numerous and they are more than of the average thickness of those found in other countries; they are of great longitudinal extent, some being traceable by their outcrops for several miles; they are strong and persistent and highly auriferous at an elevation of less than 500 feet above the sea, and they can be traced thence upwards to a height of nearly 8,000 feet; near them gold can be washed out of almost every dish of earth that is dug; the proportion of gold in some of the soils and reefs in the neighbourhood of Devala is large; and, the country presenting the greatest facilities for prosecuting mining operations at the smallest cost, it must be apparent to all who have given attention to this question that, sooner

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or later, gold-mining will be established, as an important industry in Southern India.

The retardation of this event will be caused, not by the meagreness of the resources—they are large,—but probably by the mistaken notion that wherever there is gold, all the care, all the forethought that would be deemed requisite in other pursuits may be disregarded in conducting mining operations.

We have little doubt of a report as favourable being the result of a similar examination of much of our hill-country; while in reference to the working of the reefs, the convenience for transporting machinery, the available water power, the supply of labour and the healthfulness of the climate, there can be no question that Ceylon presents very great advantages.

GOLD AND GEMS IN CEYLON.

(From the *Ceylon Observer*, April 25th, 1881.)

We have received from Mr. Auwardt specimens of quartz from his property, Mount Pleasant, near Galle. In these there is no appearance of gold, but a good deal of black mica. In some samples previously furnished, Mr. A. C. Dixon discovered traces of gold. The professional reports of this gentleman have also been laid before us, and we may extract a few passages to shew his opinion of the prospects of gold reef being found in the Southern Province near Galle. On the 15th December last, Mr. Dixon wrote:—

"I have examined the specimens of gold, gems and bag of sand which I received from you on the 9th instant with the following result:—

"*a.* The small nugget was pure gold and weighed over 6 grains.

"*b.* The stones in the paper parcel were fragments of gems such as corundum, sapphire, garnets, tourmaline, zircon, &c.

"*c.* The bag of sand contained fragments of the same mineral as *b*, abounding especially in garnets, I did not find any gold in the sample sent in bag."

On the 27th December, after a personal visit, Mr. Dixon was able to say:—

"I saw the man who found the gold and examined the place from which he took it. I requested him to dig more and wash it in my presence, after which I examined the residue. I found no trace of gold in it, but numerous fragments of gems and quartz. I then followed up the ravine to its source with the expectation of finding a quartz reef from which the gold might have come. I found two small reefs crossing the ravine and took specimens from them. These I have examined and find only a slight trace of gold not in quantity to warrant its working. There is evidence of the occurrence of gems in the vicinity. I saw several which had been taken from the opposite side of the hill, and judging from these they appear to be of as good a quality as the gems at Ratnapura but not so large in size. They were chiefly ruby, sapphire, tourmaline and cat's eye. I have no doubt larger ones will be found. I spoke to your kangani respecting the quartz reefs and have no doubt that if they were broken into, it would set the matter at rest as to whether gold is to be found there in quantity worth working. From what I saw it did not appear to be so."

Again:—

"I have examined the specimens of quartz sent on the 17th March and find in it slight traces of gold at the rate of a few *grains* per ton. There is other metallic matter in the quartz, viz. iron as a sulphide. I have no doubt from what I saw when there that better samples will be sent you."

So far therefore search at Galle has been unsuccessful, although Mr. Dixon holds out encouragement to persevere in blasting for a reef. We trust Mr. Auwardt's further efforts may be crowned with success.

We learn that the result of Mr. Harvey's hurried visit to the Dolosbage, Matale and Ambagamuwa districts has been to leave matters very much as they were, save that certain out-crops of quartz were pronounced non-auriferous and

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that of other places an opinion was expressed favourable to investigation. Mr. Harvey is a very high authority in the gold-mining world and is naturally, therefore, correspondingly cautious in the expression of his opinion. He was the first, it seems, to inspect and report favourably on the auriferous land belonging to the late firm of Messrs. William Nicol & Co. of Bombay, and his report led to the establishment of the Glenrock and other gold-mining Companies. His inspection of our hill region was far too hurried to lead to definite practical results. It may, in one sense, be said to be premature, for Mr. Harvey would be the man to call in after some progress was made in the investigation, to give a decisive opinion on the value of quartz, and the nature of a reef. Planters will act quite rightly to make available representative specimens of the quartz which they have reason to suppose to be auriferous; but, as Mr. Harvey pointed out, the proper course in the case of Ceylon where gold has been found in the river beds and nowhere else (to speak of) as yet, would be to pan and wash in the river and follow up so long as gold was found, until at last it disappeared from the washings, and *then* to look right and left and all round for the matrix reef from which the gold had gradually been denuded. Now this is work appertaining to the Government of the country. It is impossible that private individuals can undertake this duty, and we think, therefore, there is good reason for calling on the Lieut.-Governor to devote some portion of the surplus revenue from the Pearl Fishery to an investigation which may be fraught with important consequences to the revenue and prosperity of the Colony. It will be remembered that in 1854 an attempt to follow up the Mahaoya and Hingula in the manner described above, was frustrated by the advent of the south-west monsoon. Unfortunately this same rainy season is again close at hand. Mr. Harvey was greatly struck with the advantages presented to the miner in Ceylon in railway and road communication, water power, good climate, &c. He also expressed an interest in the gem-digging operations in the country and hazarded the opinion that much deeper mining both for gems and gold in suitable localities (as recommended by Sir Samuel Baker in the case of Nuwara Eliya), ought to lead to successful results. The bed of an ancient river, or the old bed of an existing river which has shifted its course, would probably be a favourite spot in which to operate for gold.

It must be remembered that Ceylon is one of the oldest geological formations. Geologistis speculate on this island having been connected with Madagascar and the Malay Peninsula by land long since submerged. They still regard a belt commencing on the east coast of Africa and across Madagascar, Ceylon, Malay Peninsula and Borneo as the most likely division in which to find the remains of the earliest human beings or of the most advanced apes, on the earth's surface. Denudation of the rocks and reefs has therefore been going on in Ceylon far longer than in most countries, and the fact that very valuable gems and evidences of gold have been found so near the surface affords good reason for anticipating greater success from deeper mining.

Since writing the above we have seen Mr, A. C. Dixon on his return from the Rakwana district. The Rangwelletenne limestone with its supposed 90 per cent of lime is a delusion. The limestone Mr. Dixon saw is poor. Gem pits exist on Everton estate to the depth of forty yards, and Mr. Dixon saw finer stones—sapphires chiefly—than any he had previously seen in the island. Two or three were valued by the Chetty owner at over £200 a piece; but Mr. Dixon fully agrees that the proper localities have probably not yet been explored for the best gems, and he is likely to recommend a trial shaft in an old river bed.

GEMS AND LIMESTONE IN THE RAKWANA DISTRICT.

(From the *Ceylon Observer*, April 26, 1881.)

We learn from Mr. Shand, senior, that the Rangwelletenne limestone so well reported on by Mr. Hughes was found in the shape of boulders in the river,

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and that Mr. Dixon could not find any of similar quality for the good reason that all the best boulders had been collected and used up for estate purposes. There exists, however, a small bed of limestone not far away which runs through native property, and which had the Superintendent of Rangwelletenne (Mr. G. D. Brabazon) not been absent from the district, he could readily have pointed out to Mr. Dixon. Altogether it is a pity that the geologist's visit to the district was not made known to proprietors generally beforehand. His attention could have been directed to what is supposed to be the richest gemming land in the district, near the Everton ridge, and also on Batakande from which, last year, it is said, £9,000 of precious stones were sold, all taken from an area not exceeding 2½ acres! The old Everton pits which were sunk to a depth of 120 feet had to be abandoned by C. M. Hassana Marikar, because he had no means of pumping out an accumulation of water. It is very evident that there is room with modern appliances and adequate capital for a Limited Company to develop a very profitable Gem-digging industry in the Sabaragamuwa district.

GOLD.

(From the *Encyclopædia Britannica*, Vol. X.)

The colour, lustre, and power of resisting oxidation, which this metal possesses, have caused it to be valued from the earliest ages. Allusions to gold are frequent in the Old Testament, and the refining of the precious metals by cupellation seems to have been a favourite illustration with the Jewish poets. (*a*) Jewellery and vessels found in Egyptian tombs afford evidence of the perfection attained in working gold at a period earlier than the Government of Joseph, (*b*) and drawings on tombs of about this epoch clearly indicate the method of conducting the operations of washing, fusing, and weighing the metal. Excavations in Etruria have brought to light beautiful ornaments of gold, enriched with minute grains of the metal, the workmanship of which was unrivalled until Castellani studied and revived the methods employed by Etruscan artists. (*c*) The Greeks were familiar with natural alloys of silver and gold named *electrum*, rough nuggets of which were frequently stamped, and formed the earliest coins in Lydia. (*d*) The colour of this electrum is pale yellow to yellowish white, and it contains from 20 to 40 per cent of silver.

With regard to the history of the metallurgy of gold, it may be mentioned that, according to Pliny, mercury was employed in his time both as a means of separating the precious metals and for the purposes of gilding. Vitruvius also gives a detailed account of the means of recovering gold, by amalgamation, from cloth into which it had been woven.

Properties.—Gold is the only metal of a yellow *colour*, which is, however, notably effected by small quantities of other metals; thus the tint is sensibly lowered by small quantities of silver, and heightened by copper. The surface colour of particles of gold is often apparently reddened by translucent films of brown iron ore. It is nearly as soft as lead. The *hardness* varies, however, with the composition. Crystallized specimens from Oregon and Fraser River, containing respectively 835 and 910 parts of gold in 1,000 are slightly harder than calc spar but sensibly softer than flour spar, or much harder than the pure metal. When pure, gold is the most *malleable* of all metals. One grain may be beaten into leaves which cover a surface of 56 square inches, and are only $\frac{1}{282000}$th of an inch thick. Faraday has shown that the thickness

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a Percy's *Metallurgy of Lead*, p. 177.
b Jacquemart, *History of Furniture*, translation, p. 331.
c *Archæological Journal*, 1861, p. 375.
d "Notes on the anceient Electrum Coins," by Barclay V. Head, *Numismatic Chronicle*, part iv., 1875, p. 245.

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of gold leaves may be still further reduced by floating them on a dilute solution of cyanide of potassium. When very thin, leaf gold appears yellow by reflected and green by transmitted light. If, however, certain gold films are heated, the light transmitted is ruby red; the pressure of a hard substance on the film so changes its state of aggregation that green light is again transmitted. (*a*) The metal is extremely *ductile*; a single grain may be drawn into a wire 500 feet in length, and an ounce of gold covering a silver wire is capable of being extended more than 1,300 miles. Gold can readily be welded cold, and thus the finely-divided metal in the state in which it is precipitated from solution may be compressed between dies into discs or medals. According to G. Ross, (*b*) the *specific gravity* of gold in the finely-divided state in which it is precipitated from solution by oxalic acid is 19·49. The specific gravity of cast gold varies from 18·29 to 19·37, and by compression (*c*) between dies the specific gravity may be raised from 19·37 to 19·41; by annealing, however, the previous density is to some extent recovered, as it then is found to be 19·40. Its *atomic weight* is variously given as follows:—196·67 (Berzelius), 196·3 (Levol), 196·5 (Wurtz), 196·0 (Watts). The number adopted in this work (CHEMISTRY, vol. v., p. 528) is 196·2. Different observers have given the following temperatures as its *melting point*:—1,425° (C. Daniell), 1,200° C. (Pouillet), 1,380° C. (Guyton de Morveau). Rimesdijk, (*d*) after comparing the several results, concludes that it may be considered to be 1,240° C. The *electric conductivity* is given by Matthiessen as 73·99 at 15·1° C., pure silver being 100; this depends greatly on its degree of purity,—the presence of a few thousandths of silver lowering its conductivity by ten per cent. The *specific resistance* of the metal in electromagnetic measure, according to the centimetre-gramme-second system of units, is 2,154. Its *conductivity for heat* is 53·2 (Wiedemann and Franz), pure silver being 100. Its *specific heat* is 0·324 (Regnault). Its *co-efficient of expansion* for each degree between 0° and 100° C. is 0·000014661, or for gold which has been annealed 0·000015136 (Laplace and Lavoisier). The *specific magnetism* of the metal is 3·47 (Becquerel). Details as to its *tenacity* and *rigidity* are given in the article ELASTICITY. With regard to its *volatility*, Gasto Claveus (*e*) states that he placed an ounce of pure gold in an earthen vessel in that part of a glass-house where the glass is kept constantly melted, and retained it in a state of fusion for two months without the loss of the smallest portion of its weight. Kunkel describes a similar experiment, which was attended with the same result. Homberg, (*f*) however, observed that when a small portion of gold is kept at a violent heat, part of it is volatilized. Both Macquer and Lavoisier showed that when gold is strongly heated, fumes arise which gild a piece of silver held in them. Its volatility has also been studied by Elsher, and, in the presence of other metals by Napier. (*g*) Hellot affirms that when an alloy of 7 parts of zinc and 1 part of gold is heated in air, the whole of the gold rises in the fumes of oxide of zinc which are produced. Gold is dissipated by sending a powerful charge of electricity through it when in the form of leaf or thin wire. In the gold *spectrum* Huggins has observed twenty-three lines, and the wave lengths of the three most important of these are 5,231, 5,835, and 6,276 respectively.

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a *Phil. Trans.*, 1857, p. 145.
b *Pogg. Ann.*, vol. lxxiii. p. 1, and lxxv. p. 408.
c *Eight Ann. Report of Deputy Master of the Mint*, 1877, p. 41.
d *Archives Neerlandaises*, t. iii., 1868.
e Quoted by Dr. T. Thomson, *System of Chemistry*, 5th edition, 1817, vol, i., p. 484.
f *Mem, Paris Academy*, 1702, p. 147.
g *Chem. Soc. Journ.*, vol. x. p. 229, vol. xi. p. 168.

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Some perliminary observations on the spectrum of the vapour at the temperature of the oxyhydrogen flame, made by Lockyer and Roberts, (*a*) showed that there was a distinct absorption both at the blue and at the red end.

The solvents for gold are given in the article CHEMISTRY, vol. v. p. 529. It may be added that finely-divided gold dissolves when heated with strong sulphuric acid and a little nitric acid. Dilution with water, however, precipitates the metal as a violet or brown powder from the solution so obtained. Gold is also attacked when strong sulphuric acid is submitted to electrolysis with a gold positive pole. (*b*) W. Skey has shown (*c*) that in substances which contain small quantities of gold, the precious metal may be removed by the solvent action of a tincture of iodine or bromine in water. Filter paper soaked with the clear solution is burnt, and the presence of gold is indicated by the colour of the ash.

Occlusion of Gas by Gold.—Graham has shown (*d*) that gold is capable of occluding 0·48 of its volume of hydrogen, and 0·20 of its volume of nitrogen. Varrentrapp has also pointed out that "cornets" from the assay of gold may retain gas if they are not strongly heated. Artificial crystals of gold may be formed when the molten metal is slowly cooled.

Occurrence and Distribution.—Gold is found in nature chiefly in the metallic state, or as native gold, and less frequently in combination with tellurium, lead, and silver, forming a peculiar group of minerals confined to a few localities in Europe and America. These are the only certain examples of natural combinations of the metal--the minute although economically valuable quantity often found in pyrites and other sulphides being probably only present in mechanical suspension, although for practical purposes it may be spoken of as combined. The native metal occurs tolerably frequently in crystals belonging to the cubic system, the octahedron being the commonest form, but other and complex combinations have been observed. Owing to the softness of the metal, large crystals are rarely well defined, the points being commonly rounded. In the irregular crystalline aggregates branching and moss-like forms are most common, and in Transylvania thin plates or sheets with diagonal structures are characteristic. These have recently been shown by Vom Rath to be repeated combinations of distorted tetrahexahedra. During the preparation of a mass of pure gold in the Mint at London, some fine crystals which appear to be aggregations of octahedra were obtained; and dendritic crystals of gold prepared artificially, have been described by Chester. It is possible also to obtain gold in crystals by heating its amalgam; according to Knaffl, an amalgam of 1 part of gold with 20 parts of mercury is maintained at a temperature of 80° C for eight days. It is then heated to 80° C. with nitric acid of specific gravity 1·35, when dull crystals will be left, which become brilliant when more strongly heated. More characteristic, however, than the crystallized are the irregular forms, which, when large, are known as "nuggets" or "pepites," and when in pieces below ¼ to ½ ounce weight as gold dust, the larger sizes being distinguished as coarse or nuggety gold, and the smaller as gold dust proper. Except the larger nuggets, which may be more or less angular, or at times even masses of crystals, with or without associated quartz or other rock, gold is generally found bean-shaped or in some other flattened form, the smallest particles being scales of scarcely appreciable thickness, which, from their small bulk as compared with their surface, subside very slowly when suspended in water, and are therefore readily carried away by a rapid current. These form the "float gold" of the miner. The physical properties of native gold are gener-

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a *Proc. Roy. Soc.*, 1875, p. 344.
b Spiller, *Chem. News*, x. 173.
c *Ibid*, xxii. 245.
d *Phil. Trans.*, 1866, 433.

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ally similar to that of the melted metal, and its alloys as described above. The composition varies considerably in different localities, as shown in the following table :—

ANALYSES OF NATIVE GOLD FROM VARIOUS LOCALITIES.

Locality.	Gold.	Silver.	Iron.	Copper.	Authority.
EUROPE.					
British Isles—					
Vigra and Clogau ...	90·16	9·26	trace.	trace.	Forbes.
Wicklow (river) ...	92·32	6·17	·78	...	Mallet.
Transylvania	60·49	38·74	...	0·77	G. Rose.
ASIA.					
Russian Empire—					
Brezovsk	91·88	8·03	trace	·09	G. Rose.
Ekaterinburg	98·96	0·16	·05	·35	...
AFRICA.					
Ashantee	90·05	9·94	...	...	...
AMERICA.					
Brazil	94·00	5·85	...	...	D'Arcet.
Central America	88·05	11·96	...	...	Fremy and Pelouze.
Titiribi	76·41	23·12	...	0·87	Rose.
California	90·12	9·01	...	...	...
Mariposa	81·00	18·70	...	...	F. Claudet.
Cariboo	84·25	14·90	...	·03	Claudet.
AUSTRALIA.					
South Australia	87·78	6·07	6·15	...	A. S. Thomas
Ballarat	99·25	0·65	...	...	Claudet.

Of the minerals containing gold the most important are sylvanite or graphic tellurium, of composition (AgAu) Te, with 24_2 to 26 per cent; calaverite, $AuTe_2$, with 42 per cent; and nagyagite or foliate tellurium, of a complex and rather indefinite composition, with 5 to 9 per cent of gold. These are confined to a few localities, the oldest and best known being those of Nagyag and Ofenbanya, in Transylvania; but latterly they have been found in some quantity at Red Cloud, Colorado, and in Calaveras county, California—the nearly pure telluride of gold, calaverite, being confined to these places.

The minerals of the second class, usually spoken of as auriferous, or containing gold in sensible quantity, though not to a sufficient amount to form an essential in the chemical formulæ, or even in many instances to be found in the quantities ordinarily operated upon in analyses, are comparatively numerous, including many of the metallic sulphides. Prominent among these are galena and iron pyrites,—the former, according to the observations of Percy and Smith, being almost invariably goldbearing to an extent that can be recognized in operating upon a pound weight of the lead smelted from it, the

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proportion increasing to some extent with the amount of silver. (*a*) The second is of greater practical importance, being in some districts exceedingly rich, and, next to the native metal, is the most prolific source of gold. Magnetic pyrites, copper pyrites, zinc blende, and arsenical pyrites are other and less important examples,—the last constituting the gold ore formerly worked in Silesia. A native gold amalgam is found as a rarity in California, and bismuth from South America is sometimes rich in gold. Native arsenic and antimony are also very frequently found to contain gold and silver.

The association and distribution of gold may be considered under two different heads, namely, as it occurs in mineral veins, and in alluvial or other superficial deposits which are derived from the waste of the former. As regards the first, it is chiefly found in quartz veins or reefs traversing slaty or crystalline rocks, usually talcose or chloritic schists, either alone, or in association with iron, copper, magnetic and arsenical pyrites, galena, specular iron ore, and silver ores, and more rarely with sulphide of molybdenum, tungstate of calcium, bismuth, and tellurium minerals. Another more exceptional association, that with bismuth in calcite from Queensland, was described by the late Mr. Daintree. In Hungary, the Urals, and Northern Peru, silicates and carbonates of manganese are not uncommonly found in the gold and silver bearing veins. In the second or alluvial class of deposits, the associated minerals are chiefly those of great density and hardness, such as platinum, osmiridum, and other metals of the platinum group, tinstone, chromic, magnetic, and brown iron ores, diamond, ruby and sapphire, zircon, topaz, garnet, &c., which represent the more durable original constituents of the rocks whose disintegration has furnished the detritus. Native lead and zinc have also been reported among such minerals, but their authenticity is somewhat doubtful.

The distribution of gold-bearing deposits is world-wide; although the relative importance of different localities is very different, their geological range is also very extensive. In Europe the principal groups of veins are in slaty or crystalline schists, whose age, when it can be determined, is usually Palæozoic, Silurian, Devonian, or Carboniferous, and less commonly in volcanic formations of Tertiary age. The alluvial deposits, being more extensive, are less intimately connected with any particular series of rocks. Few of either are however, of much importance as compared with the more productive deposits of America and Australia. In the United Kingdom goldbearing quartz veins were worked during the Roman occupation at Ogofau, near Llanpumpsant, in Carmarthenshire, and in the year 1863 as much as 5,300 oz. was produced from similar veins in Lower Silurian slates at Vigra and Clogau mines, near Dolgelly. In 1875 the mine was re-opened, and in 1878 it produced 720 oz. Tetradymite, native bismuth, and several other characteristic associates of gold were also found in small quantity. In Cornwall small pieces of native gold have at intervals been found in alluvial or stream tin works; and similar but more important finds have been made in the granite district of Wicklow, and more recently at Helmsdale, in Sutherlandshire. The largest nugget of British origin weighs under 3 oz.

On the continent of Europe the great rivers originating in the crystalline rocks of the Alpine region, such as the Rhine and Danube, are slightly auriferous in their alluvial deposits in several places; but the proportion of gold is extraordinarily minute, so that the working is only carried on by gipsies, or by the local peasantry at irregular intervals, the return for the labour expended being very small. The same remark applies to the Rhone and its affluents, and the rivers of the central granitic mass of France. In the Austrian Alps the gold quartz mines at the Rathausberg, near Gastein, at a height of about 9,000 feet above ths sea-level, and at Zell, in Tyrol, are of interest historically as having developed the system of amalgamation in mills, although they are economically of small import-

a *Phil. Mag*, viii., 1854, p. 126.

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ance at present. On the Italian side, in the Valanzasca and Val Toppa above Lago Maggiore, a group known as the Pestarena mines have yielded from 2,000 to 3,000 ounces annually for several years past; and more recently a discovery of great interest of a highly auriferous copper ore has been made at Ollomont in the Val d'Aosta. In Hungary the gold-bearing veins of Schemnitz occur in greenstones and trachytes of Tertiary age, the most powerful example, the *Spitaler-gang*, being filled with a mixture of quartz and brown iron ore known as zinnopal, and containing gold associated with silver ores, galena, and pyrites. In Transylvania, at Nagyag, the gold-bearing tellurium minerals previously noticed are found in small veins traversing greenstone trachyte. These are often very thin, as low as ⅛th to 1-16th of an inch, but each is carefully traced, out, the rock being impregnated with gold and silver to a certain depth on each side. At Vorospatak, another Transylvanian locality, gold with a very large proportion of silver and associated with gypsum is worked in veins traversing a Tertiary sandstone, being almost the only known instance of such a mode of occurrence.

The Russian empire has the largest gold production among the countries of the Old World, most of the produce, however, being derived from its Asiatic territories. The more important localities are situated on the eastern slope of the Ural chain, extending in a nearly north and south line for more than 600 miles from 51° to 60° N. late. The chief centres are Miask (55° N.), Kamensk (56° 30' N), Berezovsk (57° N.), Nijne Tagilsk (58° N.), and Bogoslowsk (60° N.), the known deposits, which include both veins and alluvial mines, extending for about one degree farther north. The geological age of the Ural veins is not very well defined—strata of the Silurian, Devonian, and Carboniferous. periods, which form regular paralled alternations on the European slope, being present on the Asiatic side, but in much disturbed and contorted positions, in association with plutonic rocks, diorite, diabase, and granite, with which the gold veins are intimately connected. The latter are therefore of post-Carboniferous and probably of Permian date. At Berezovsk the mines cover an area of about 25 square miles, mainly composed of talcose, chloritic, and clay slates, vertical or sloping at high angles, and penetrated by dykes of beresite, a fine grained rock made up of quartz and white mica with some felspar and pyrites, the latter usually transformed into brown iron ore. These dykes, which have a general north-and-south direction are vertical, and are from 20 to 70 feet and upwards in thickness, are traversed perpendicularly to their direction by veins of quartz from the thinnest string to a maximum of 3½ or 4 feet thick, in which gold is associated with brown iron ore or ochres, resulting from the decomposition of pyrites. The workings being essentially shallow, none of the associated sulphides, galena, bisulphide of copper, &c., have as yet been found, as a rule, to be gold-bearing. The valuable parts of the veins are almost entirely restricted to the beresite dykes. The richest of the Ural mines are those of Smolensk, near Miask, and Ouspensk, near the village of Katchkar, in 52° N. The alluvial deposits which, though called sands, are but very slightly sandy clays extend to the north beyond the inhabited regions, and to the south into the Cossack and Bashkir countries. The most valuable diggings are in the district of Miask, where the largest nuggets have been found, and in the Katchkar, which are remarkable for the great number of gems, pink topazes, emeralds, &c., found in connexion with the gold. Magnetite, quartz, and platinum are very common in all the Ural gold sands: less common are hematite, titaniferous and chromic iron, pyrites, garnet, and, least of all zircon, kyanite, and diamond. These alluvial deposits are of later Tertiary age, some of them containing traces of prehistoric human work: others are post-Pliocene, with the remains of the mammoth, tichorrhine, rhinoceros, and other mammalian fossils. Somewhat similar conditions prevail in the alluvial gold region of the Altai. Besides the veins and alluvial deposits, the Ural rocks, such as serpentine, diorite, beresite, agrairite, &c., are at times auriferous.

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The gold deposits of the Caucasus, though immortalized in the tradition of Jason and the Argonauts, are now entirely abandoned, the last attempt at working them having been suspended in 1875.

In India gold is obtained in small quantities by native gold-washers in various parts of the highlands of southern Bengal, and more recently quartz veins and alluvial deposits of considerable promise have been discovered in the district of Wynaad, in the southern part of the Madras Presidency.

On the Atlantic slopes of North America, the chief gold-bearing localities are on the Chaudiere river, near Quebec, and in Nova Scotia. In both instances the quartz veins worked are contained in slates belonging to the Quebec group of the Lower Silurian period, those of the latter province being specially remarkable for their quasi-stratified character, as they penetrate the slates at a very low angle of inclination, and have been folded and corrugated together with the containing rocks by subsequent disturbances. Other deposits of old geological periods are found in Tennessee and North Carolina.

On the Pacific side of America gold is found under very different conditions and on a much larger scale than on the Atlantic side. The whole distance from Mexico to Alaska may be said to be more or less auriferous, the most extensive deposits being in the great north-and-south valley of the Sacramento, which runs parallel to the coast, between the so-called Coast Mountains and the Sierra Nevada, the latter being distinguished further to the north in the Cascade range. Others of less extent are known in the Klamath, Columbia, and Fraser River basins; they extend in the last two far back into the interior to the region between the Cascade range and the Rocky Mountains. In many of these valleys alluvial deposits are developed to an extent unparalleled elsewhere, the river channels being bordered by banks or benches of gravel and sand, rising in terraces to considerable heights on the flanks of the hills. For example, at the Methow, a tributary of the Columbia, there are sixteen lines of such terraces the highest about 1,200 feet above the river; and at Colville, on the Columbia, traces of old terraces, much degraded by frost and rain, are seen at 1,500 feet above the river. These gravels, which are of Pliocene and more recent origin, are in many places, though very unequally auriferous, the richest points being found in the bars or shingle banks of the river after the summer floods, and in the channels of the smaller tributary streams, where the poorer material has been partially enriched by a process of natural washing. The most extensive, or rather the best known because most completely explored, deposits of this class are those of the Upper Sacramento Valley, in California (see vol. iv., p. 701). (*a*) Others of considerable importance are worked in the Cariboo district on the Upper Fraser River, yielding very coarse gold. Another discovery of a singular character, the produce being a regular gold gravel, was made some years back at Salmon River in Oregon, but the deposit, though exceedingly rich, was soon exhausted. Gold-bearing quartz veins are also common over a large part of California, notably in Grass Valley (vol. iv.. p. 702), in strata that are supposed to be of Triassic age, the associated minerals being iron and arsenical pyrites, galena, &c. In Calaveras county, tellurium ores like that of Transylvania are characteristic of the gold veins. In the adjacent States of Nevada and Colorado, gold is so intimately associated with silver ores, that it is for the most part only obtained from the ultimate process of refining the reduced silver. The same remark applies to the most of the mines of Mexico, and on the south-west coast of America, in Peru, Bolivia, and Chili. (See SILVER.)

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a See also Whitney, *On the Auriferous Gravels of the Sierra Nevada* Cambridge, U. S., 1879.

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Very rich gold quartz has been brought from Carabaya on Lake Titicaca; and recently considerable deposits both alluvial and in veins have been opened at Caratal in Venezuela and at St. Elie in French Guiana, which are interesting as proving the actual existence of Raleigh's Eldorado.

In Brazil the principle gold mines are upon veins in clay slate, and a peculiar class of rocks known as Jacotinga or Itabirite, and which are mixtures of quartz, chlorite, and specular iron ore, the latter often occurring in large mirror-like crystals several inches across. The gold occurs almost entirely in pyritic minerals, being most abundant in ordinary iron pyrites, and less so in magnetic and arsenical pyrites, free gold being rarely seen. (See BRAZIL, vol. iv., p. 224.)

In Africa the chief gold-bearing localities are on the west coast—gold dust derived from alluvial washings forming an article of export from many of the trading stations along the Guinea coast. Latterly, alluvial deposits have been worked in the mountains of Transvaal, in the Leydenburg district (25° S. lat. 31° E. long.), producing coarse nuggetty gold in masses up to 11 lb weight, and in a few cases gold-bearing quartz has been found in veins in talcose schist and quartzite, closely associated with eruptive masses of diorite. The age of these rocks is considered by Dunn (*a*) to be Silurian or Devonian, and the observed phenomena to be similar to those generally observed in Australia. The upper valley of the Nile produces a little gold in Abyssina and Nubia, the latter being the land of gold of the old Egyptains. Very extensive ancient mines have been described by Linant Bey in the district known as Attaki or Allaki on the Red Sea, situated about 120 miles back from Râs Elba, the headland midway between Berenice and Sauwakin. These are probably the same mines that were described by Diodorus Siculus, and one of the oldest topographical documents known, a map or itinerary of the route to them from the Nile, is preserved at Turin. In the reign of Setee I., of the 19th dynasty, wells were opened along this route, in order that the mines, that were then of very great antiquity, might be reopened. (*b*) Similar ancient gold mines have recently been discovered by Burton in the land of Midian, on the east coast of the Gulf of Akaba.

The gold districts of Australia cover a very considerable area, extending from the east side of the continent for about 20° of latitude (18° to 38° S.), the more important deposits being those of Victoria in the South. The principal districts are in Victoria,—Ballarat, Castlemaine, and Sandhurst, lying west and north from Melbourne, and Beechworth near the Murray River to the north-east. In New South Wales the gold-fields are scattered over the entire length of the colony from north to south, the more important districts lying between the 32nd and 36th parallels of S. lat. on the western side of the Australian cordillera, on the upper tributaries of the Macquarie and Lachlan rivers, the centre being about the town of Bathurst. This is known as the western districts. Another group, known as the northern district, is on the eastern side of the mountains near the Queensland boundary, in 29° S., Rocky River being the principal locality: while the southern district includes Braidwood, Adelaide, Tumbarumba, and other localities near the Murray River. In Queensland the chief localities are, commencing on the south, Gympie and Kilkevan near Maryborough, 26° S. lat.; a group extending about 50 miles north and south of Rockhampton, in 24° 30′ S. lat., all near the coast; Eastern River, Hurley, and Peak Downs about 300 miles inland on the 23rd parallel; and Colmenny and Gilbert on a stream running in to the Gulf of Carpentaria, besides numerous others. In all those localities two principal kinds of deposits are observed, namely, auriferous quartz veins traversing slates of Silurian and Devonian age, which are in intimate relation with masses of diorite and other eruptive rocks; and gold-bearing drifts of Miocene or even newer Tertiary date, derived from

a *Quarterly Journal of the Geological Society*, xxxiii, p. 882.

b Mariette Bey, *Histoire Ancienne d' Egypt*, 1867, p. 96. The oldest notice of the mines goes back to the 12th dynasty.

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the degradation of the older strata. According to Daintree, (*a*) no auriferous vein of any kind has been found in any Secondary or Tertiary strata, or in the igneous rocks erupted through any such newer formations; and as a result of his experience, the same observer gives the following as the modes of occurrence of gold in Australia:—(1) In pyritic diorites and felstones in Queensland, and their alluvial drifts; (2) in pyritic granites in New South Wales; (3) in drifts from auriferous serpentine in Queensland, also in the two northern colonies; (4) in more or less reqular veins with quartz and calcspar in the preceeding rocks; (5) in quartz and other veins in Devonian and Upper Silurian strata in proximity to similar igneous rocks, which is the general character of the Victoria quartz veins; (6) in veins of metamorphic rocks of unknown age in Queensland; and (7) in quartz veins in Lower Silurian strata, without any apparent connexion with igneous masses. The latter occur only in Victoria, and are of comparatively minor importance. In the northern territory of South Australia, alluvial gold mining has recently been developed to a considerable extent in the neighbourhood of Port Darwin in the Gulf of Carpentaria, the export being from 2,000 to 3,000 oz. monthly.

Statistics.—There are no means of stating exactly the total gold produce of the world for any particular year, as in many of the larger producing countries no systematic returns are obtained, and in others where such returns are collected, their publication is often delayed for a considerable time. The following figures, mostly derived from a recent statistical work, A Soetbeer, *Edelmetall-Produktion*, 1879, with some additions from late official sources, will give some idea of the relative importance of the different countries. Previous to 1837 the first place was held by Russia, and the estimated average annual yield from all sources was in the decennial period 1841-50, 1,760,500 ounces.

The contributions of the different countries are as follows:—

	oz.		oz.		oz.
United States......1876	2,050,000(*b*)				
Russia 1876	1,072,920	1877	1,281,260		
New South Wales..1876	126,789	1877	97,582		
Victoria...............1876	963,760	1877	809,653	1878	758,039
Queensland 1876	410,330	1877	468,418		
New Zealand........1876	322,016	1877	371,685	1878	311,438
Venezuela...........				1878	150,000
New Granada......1876	112,500				
Africa..................1875	110,100				
Mexico 1875	65,950				
Bolivia 1875	64,300				
Austria-Hungary .1876	61,214				
Brazil 1875	55,300				
Japan 1876	21,660				
Chili... 1876	12,860				
Nova Scotia.........1876	12,039				
Peru....................1876	11,570				

Since 1851 the yield has been very largely increased by the discovery of the Australian and Californian sources, the annual averages being—

In 1851...1855...	6,350,180	ounces
„ 1856 ..1860...	6,624,850	„
„ 1861 . 1866...	5,951,770	„
„ 1866...1870...	6,169,660	„
„ 1871...1875...	5,487,400	„

a Quarterly Journal of the Geological Society, vol. xxxiv. p. 435.

b The two principal mines, on the Comstock lode, the Consolidated Virginia and California, produced, apart from silver, gold of the value in United States currency as follows:—

	1876.		1877.		1878.
Consolidated Virginia...	$7,378,145	...	$6,270,000	...	$3,770,000
California	6,648,641	...	9,386,745	...	5,553,400

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Proportion of Gold in Deposits.—A rich gold-bearing deposit is quantitatively very different from one to which the same term is applied when containing ores of other metals. In the latter the useful material must as a rule from a considerable proportion—one or more parts in a hundred—of the mass; while in the former, owing to the superior value of the product, it rarely attains as much as 1 per cent, and is generally very much less, the amount of gold contained in easily-worked alluvial deposits being often extremely small. For example, the yield of the Siberian gold washings ranges from 12 grains to 1 cwt. 12 grains per ton; (*a*) while in the lodes, which are more difficult and expensive to work, the proportion is about 8 dwts. per ton. In the alluvial washing of California it is estimated at about two shillings worth, equal to about 1-40th of an ounce, per ton of gravel. In Australia the alluvail ground worked in the colony of Victoria in 1878 is returned as averaging 25 grains (1 dwt. 1 gr.) per ton, or about double the above quantity.

In vein mining, which is more difficult and costly, a larger yield is necessary, but probably 5 dwts., or about £1 in value per ton, will in most places represent paying quantities from quartz containing free gold *i. e.*, not associated with pyrites. The proportional yield and quantities of the different kinds of auriferous materials treated in the colony of Victoria during the last three months of 1878 were:—

	Tons.	Yield per ton. oz.	dwt.	gr.
Alluvial sand "washdirt"	173,379	1	1	59·6
Cement (gravel) requiring crushing	5871	...	4	21·4
Quartz	222·775	...	9	21
Quartz tailings	11·139	...	1	18
Pyrites and blanketing (ore collected on blanket tables)	1·599	2	6	13·7

In the less tractable minerals, such as arsenical pyrites occurring in the lower portions of the veins, as much as 1½ to 3 oz. may be required for profitable working. When associated with the ores of other metals, such as silver, lead, and copper, the extraction of the gold is in most cases an incidental and final operation in their metallurgical treatment, and may, therefore, be best considered in the articles on these metals.

Mining.—The various deposits of gold may be divided into two classes—"veins" and "placers." The vein mining of gold does not greatly differ from that of similar deposits of metals. It will only be necessary to refer here to certain details of the extraction of gold in such cases. In the placer or alluvial deposits, the precious metal is found usually in a water-worn condition imbedded in earthy matter, and the method of working all such deposits is based on the disintegration of the earthy matter by the action of a stream of water, which washes away the lighter portions and leaves the denser gold. In alluvial deposits the richest ground is usually found in contact with the "bed rock"; and, when the overlying cover of gravel is very thick, or, as sometimes happens, when the older gravel is covered with a flow of basalt, regular mining by shafts and levels, as in what are known as tunnel-claims, may be required to reach the auriferous ground. In the early days of gold washing in California and Australia, when rich alluvial deposits were common at the surface, the most simple appliances sufficed; the most characteristic being the "pan," a circular dish of sheet iron with sloping sides about 13 or 14 inches in diameter. The pan, about two-thirds filled with the "pay dirt" to be washed, is held in the stream or in a hole filled with water. The miner, after separating the larger stones by hand, imparts a gyratory motion to the pan by a combination of shaking and twisting movements which it is impossible to describe exactly, so as to keep its contents suspended in the stream of water, which

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a 1 dwt. per ton corresponds to 1 part in 653,333 by weight, and about 1 in 5 or 6 millions by volume.

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carries away the bulk of the lighter material, leaving a black residue consisting of magnetic iron ore and other heavy minerals, together with any gold which may originally have been present in the mass. The washing is repeated until enough of the enriched sand is collected, when the gold is finally recovered by careful washing or "panning out" in a smaller pan. In Mexico and South America, instead of the pan, a wooden dish or trough, variously shaped in different districts, and known as "batea," is used.

The "cradle," a simple appliance for treating somewhat larger quantities, varies in length from 3 feet 6 inches to 7 feet, but the shorter length is that usually adopted. Its nature will be evident from fig. 1, in which *a* is a movable hopper with a perforated bottom of sheet iron in which the "pay dirt" is placed. Water is poured on the dirt, and the rocking motion imparted to the cradle causes finer particles to pass through the holes in the hopper on to the screen *b*, which is of canvas, and thence to the base of the cradle, where to the auriferous particles accumulate on the transverse bars of wood *c*, called "riffles." Washing by the cradle, which is now but little used except in preliminary workings, is tedious and expensive.

The "tom" is a sort of cradle with an extended sluice placed on an incline of about 1 foot in 12. The upper end contains a perforated riddle plate which is placed directly over the riffle box, and under certain circumstances mercury may be placed behind the riffles Copper plates amalgamated with mercury are also used when the gold is very fine, and even in some instances amalgamated silver coins have been used for the same purpose. Sometimes the stuff is disintegrated with water in a "puddling machine," which is used, especially in Australia, when the earthy matters are tenacious and water scarce. The machine frequently resembles a brickmaker's washmill, and is worked by horse or steam power.

In workings on a larger scale, where the supply of water is abundant, as in California, sluices are generally employed. They are shallow troughs about 12 feet long, about 16 to 20 inches wide, and 1 foot in depth. The troughs taper slightly, so that they can be joined in series, the total length often reaching several hundred feet. The incline of the sluice varies with the conformation of the ground and the tenacity of the stuff to be washed, from 1 in 16 to 1 in 8.

Fig 2 represents one of the simplest forms of sluice as used in river diggings in the north-west of America. A rectangular trough of boards, whose dimensions depend chiefly on the size of the planks available, is set up on the higher part of the ground at one side of the claim to be worked, upon trestles or piers of rough stone-work, at such an inclination that the stream may carry of all but the largest stones, which are kept back by a grating of boards about 2 inches apart at *a*. The gravel, which in this particular instance is from 12 to 16 feet thick, and with an average breadth to the river of 25 to 30 feet, is dug by hand and thrown in at the upper end, the stones kept back being removed at intervals by two men with four-pronged steel forks. The floor of the sluice is laid with riffles made of strips of wood 2 inches square laid parallel to the direction of the current (as at *b*, and in cross section at *c*), and at other points *d* with boards having transverse notches filled with mercury. These were known originally as Hungarian riffles The bottom of the working, which is below the drainage level of the valley, is kept dry by a Chinese bucket pump *e*, attached to a rough undershot wheel driven by the current in the sluice. The sluice boxes are made in lengths, and united together spigot and faucet fashion, so that they may easily be removed and re-erected as the different parts of the claim are progressively exhausted.

In the larger and more permanent erections used in hydraulic mining, the upper ends of the sluices are often cut in rock or lined with stone blocks, the grating stopping the larger stones being known as a "grizzly."

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In order to save very fine and especially rusty particles of gold, so-called "under-current sluices" are used; these are shallow wooden tanks, 50 square yards and upwards in area, which are placed somewhat below the main sluice, and communicate with it above and below, the entry being protected by a grating, so that only the finer material is admitted. These are paved with stone blocks or lined with mercury riffles, so that from the greatly reduced velocity of flow, due to sudden increase of surface, the finer particles of gold may collect. In order to save finely-divided gold, amalgamated copper plates are sometimes placed in a nearly level position, at a considerable distance from the head of the sluice, the gold which is retained in it being removed from time to time. Sluices are often made double, and they are usually cleaned up—that is, the deposit rich in gold is removed from them—once a week. The gold is then recovered by "panning."

The application of a jet of water to the removal of auriferous gravels by the so-called hydraulic system of mining has already been noticed at vol. iv., p. 701. *(a)* This method has for the most part been confined to the country of its invention. California, and the western territories of America, where the conditions favourable for its use are more fully developed than elsewhere,—notably the presence of thick banks of gravel that cannot be utilized by other methods, and abundance of water, even though considerable work may be required at times to make it available. The general conditions to be observed in such workings may be briefly stated as follows:—(1) The whole of the auriferous gravel, down to the "bed rock," must be removed—that is, no selection of rich or poor parts is possible; (2) this must be accomplished by the aid of water alone, or at times by water supplemented by gunpowder; (3) the conglomerate must be mechanically disintegrated without interrupting the whole system; (4) the gold must be saved without interrupting the continuous flow of water; and (5) arrangements must be made for disposing of the vast masses of improverished gravel.

The general appearance of an hydraulic gold working is seen in fig. 3, the water being brought from a ditch on the high ground, and through a line of pipes to the distributing box, whence the branch pipes supplying the three jets diverge. The stream issues through a nozzle resembling that of a fire engine (fig 4), which is movable in a horizontal plane around the vertical axis *a*, and in a vertical plane on the spheric 1 joint and centre *b*, so that the direction of the jet may be varied through considerable angles by simply moving a handle. The material of the bank, being loosened by the cutting action of the water, crumples into holes, or "caves in," and the superincumbent mass, often with large trees and stones, falls into the lower ground. The stream, laden with stones and gravel, passes into the sluices, where the gold is recovered in the manner already described. Under the most advantageous conditions the loss of gold may be estimated at 15 or 20 per cent, the amount recovered representing a value of about two shillings per ton of gravel treated. The loss of mercury is about the same, from 5 to 6 cwt. being in constant use per mile of sluice. About 1 cwt. is added daily in at least two charges. The average half-yearly consumption is estimated at about one hundred flasks of 74 lb. each, after allowing for the amount recovered in clearing up and distillation of the amalgam. The latter operation is performed at intervals of seven or fourteen days in the upper lengths of the sluice, and half-yearly in the lower parts.

The dressing or mechanical preparation of vein stuff containing gold is generally similar to that of other ores, except that the precious metal should be removed from the waste substances as quickly as possible, even although

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a Much valuable information on this subject will also be found in the *Fifth Annual Report of the United States Commissioners of Mining Statistics*, Washington, 1873, p. 390.

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other minerals of value that are subsequently recovered may be present. This is usually done by amalgamation with mercury. In all cases the quartz or other vein stuff must be reduced to a very fine powder as a preliminary to further operations. This may be done in several ways, *e.g.*, either (1) by the Mexican crusher or *arrastra*, in which the grinding is effected upon a bed of stone, over which heavy blocks of stone attached to cross arms are dragged by the rotation of the arms about a central spindle, motion being furnished by mules or other power, or (2) by the Chilian mill of *trapiche*, also known as the edge-runner, where the grinding stones roll upon the floor, at the same time turning about a central upright,—contrivances which are mainly used for the preparation of silver ores; but by far the largest proportion of the gold quartz of California and Australia is reduced by (3) the stamp mill, which is similiar in principal to that used in Europe for the preparation of tin and other ores, but has received special modification in many details. Fig. 5 represents the ordinary Californian pattern of a stamp mill. The stamp is a cylindrical iron pestle faced with a chilled cast-iron shoe removable so that it can be renewed when necessary, attached to a round iron rod or lifter, the whole weighing from 600 to 800 lb. The lift is effected by cams acting on the under surface of tappets *a*, and formed by cylindrical boxes keyed on to the stems of the lifter about one-fourth of their length from the top. As, however, the cams, unlike those of European stamp mills, are placed to one side of the stamp, the latter is not only lifted but turned partly round on its own axis, whereby the shoes are worn down uniformly. The bed or mortar A is of cast-iron. The height of lift may be between 8 and 10 inches, and the number of blows from 30 to 90 per minute. The stuff, previously broken to about 2 inch lumps in a Blake's rock breaker, is fed in through the aperture *n* at the back of the "battery box," a constant supply of water being given from the channel *k*, and mercury in a finely-divided state is added at frequent intervals. The discharge of the comminuted material takes place through the aperture *d*, which is covered by a thin steel plate perforated with mumerous slits about 1-50th inch broad, and 1-10th to ⅛th inch long, a certain volume being discharged at every blow and carried forward by the flushing water over the apron or table in front *m*, covered by copper plates filled with mercury. Similar plates are often used to catch many particles of gold that may be thrown back, while the main operation is so conducted that the bulk of the gold may be reduced to the state of amalgam by bringing the two metals into intimate contact under the stamp head, and remain in the battery. The tables in front are laid at an incline of about 8 degrees, and are about 13 feet long; they collect from 10 to 15 per cent of the whole gold; a further quantity is recovered by leading the sands through a gutter about 16 inches broad and 120 feet long, also lined with amalgamated copper plates, after the pyritic and other heavy minerals have been separated by depositing in catch pits and other similar contrivances.

When the ore does not contain any considerable amount of free gold, mercury is not, as a rule, used in the battery. The pulverized stuff is received upon blanket tables or sluices. These are inclined boards covered with coarse woollen cloth or sacking. The heavier particles become entangled in the fibres of the cloth, while the lighter deposits are carried forward by the current. At intervals of a quarter to half an hour the surface of the blanket is completely covered, when it is removed, and its contents are washed off in a tub of water and reserved for further treatment. This consists of amalgamation, in a contrivance analogous to the Hungarian mill subsequently described, and subsequent treatment in pan amalgamators somewhat similar to the *arrastra* in character, but with grinding surfaces of iron instead of stone.

At Schemnitz, in Hungary, quartz vein stuff containing a little gold, partly free and partly associated with pyrites and galena, is, after stamping in mills similar to those described above, but without rotating stamps, passed

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through the so-called Hungarian gold mill, fig. 6. This consists of a cast-iron pan *a*, having a shallow cylindrical bottom *b*, holding 50 lb. of mercury, in which a wooden runner *c*, nearly of the same shape as the inside of the pan, and armed below with several projecting blades, is made to revolve by gearing wheels placed either above, or, as in the figure, below. The connexion of the runner with the driving shaft is effected by the three-armed crutch shown in plant at *e*, which sits on the square part of the shaft. By means of set screws analogous to those of a flour mill, the runner is adjusted at such a height that the knives just clear the surface of the mercury. The stuff from the stamps arrive by the gutter *f*, and, falling through the hole in the middle of the runner, is distributed over the mercury, when the gold subsides in virtue of its superior density, while the quartz and lighter materials are guided by the blades to the circumference and are discharged at *g*, usually into a second similar mill, and sometimes to a third, placed at lower levels, and subsequently pass over blanket tables. The most advantageous speed is from 12 to 14 revolutions per minute. The action of this so-called mill is really more nearly analogous to that of a centrifugal pump, as no grinding action takes place in it. The amalgam is cleaned out about once a month. The average amount of gold collected from 50 tons of stuff stamped, is about 6 oz. in the mills, and in the subsequent dressing processess 1 lb. of auriferous silver and 10 cwt. of lead. According to Rittinger, mercury that has been purified by distillation acts much more rapidly upon gold than such as has been saturated with the metal without losing its fluidity, although the amount that can be so dissolved is very small.

There are various forms of pan amalgamators of which space will not permit a description to be given. It may be stated, however, that experience of the great variety of pans that have from time to time been devised has led to the adoption of the more simple forms, in which the grinding is effected between horizontal flat surfaces instead of curved or conical bottoms, and in the pans now usually employed the flat grinding surfaces form an annular floor round a central cone through which a vertical shaft passes. The Knox pan, fig. 7, may be considered to be fairly typical. It is of cast-iron, 4 feet in diameter and 14 inches deep. It has a false bottom to form a hollow annular space through which steam can be introduced. The centre of the yoke *d* attached to muller *m*, is keyed to a vertical wrought-iron shaft S, 2 inches in diameter, which can be brought in connexion with the driving gear G. The blocks *r*, *r* are of wood. In working the pan 100 lb. of skimmings are introduced, and water added until the pulp will just adhere to a stick. After three hours' grinding the pulp is heated with steam. About 5 lb. of mercury are added for every charge, together with a cupful of equal parts of saltpetre and sal ammonica. After three hours' further working, water with a little caustic lime is added, and the pulp is discharged first through an upper and then through a lower hole.

One of the greatest difficulties in the treatment of gold by amalgamation, and more particularly in the treatment of pyrites, arises from the so-called sickening or flouring of the mercury; that is, the particles, losing their bright metallic surfaces, are no longer capable of coalescing with or taking up other metals. Of the numerous remedies proposed, the most efficacious is perhaps sodium amalagam. It appears that amalagamation is often impeded by the tarnish found on the surface of the gold when it is associated with sulphur, arsenic, bismuth, antimony, or tellurium. Wurtz (*a*) in America (1864) and Crookes in England (1865) made independently the discovery that, by the addition of a small quantity of sodium to the mercury, the operation is much facilitated. It is also stated that sodium prevents both the "sickening" and the "flouring" of the mercury which is produced by certain associated minerals. Cosmo Newberry has investigated with much care the action of certain metals in impeding amalgamation. (*b*)

a *American Journal of Science and Arts*, vol. xli., March, 1866.
b Ure's *Dictionary of Arts*, Supplement to 7th ed., p. 412.

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Wurtz recommends to amalagams, one containing 2 and the other 4 per cent of sodium, and in practice 1 per cent or less of these is added to the mercury in the amalgamator. Crookes employs three kinds, which he calls A, B, and C amalgams; each contains 3 per cent of mercury, but the B variety has, in addition to the sodium, 20 per cent of zinc, and C is mixed with 10 per cent of zinc and 10 per cent of tin. The addition of cyanide of postssium has been suggested to assist the amalgamation and to prevent "flouring" but Skey (*a*) has shown that its use is attended with loss of gold.

Separation of Gold from the Amalgam.—The amalgam is first pressed in wetted canvas or buckskin in order to remove excess of mercury. According to Rittinger, mercury will dissolve from 0·05 to 0·08 per cent of native gold of standard 650 to 850 without loss of fluidity, the solubility of the gold increasing with its fineness; and until the point of saturation is reached, no separation of solid amalgam is possible. Lumps of the solid amalgam, about 2 inches in diameter, are introduced into an iron vessel lined with a paste of fire-clay and wood ashes, and provided with an iron tube that dips below the surface of water. The distillation is then effected by heating, care being taken that the retort does not become visible red in daylight. The amalgam yields about 30 to 40 per cent of gold. In California the amalgam is retorted in cast-iron pans placed in cast-iron cylinders 11 inches in diameter, 4 feet 6 inches long, supported on brick work. The bullion left in the retorts is then melted in black-lead crucibles, with the addition of small quantities of suitable fluxes.

The extraction of gold from auriferous minerals by fusion, except as an incident in their treatment for other metals is very rarely practised. It was at one time proposed to treat the concentrated black iron obtained in the Ural gold washings, which consists chiefly of magnetite, as in iron ore, by smelting it with charcoal for auriferous pig-iron, the latter metal possessing the property dissolving gold in considerable quantity. By subsequent treatment with sulphuric acid the gold could be recovered. Experiments on this point were made by Anossow in 1833, but they have never been followed in practice.

Gold in galena or other lead ores is invariably recovered in the refining or treatment of the lead and silver obtained. Pyritic ores containing copper are treated by methods analogous to those of the copper smelter. This is extensively done. In Colombo the pyritic ores containing gold and silver in association with copper are smelted in reverberatory furnaces for regulus, which, when desilverized by Ziervogel's method, leaves a residue containing 20 or 30 ounces of gold per ton. This is smelted with rich gold ores, notably those containing tellurium for white metal or regulus; and by a following process of partial reduction analogous to that of selecting in copper smelting, "bottoms" of impure copper are obtained in which practically all the gold is concentrated. By continuing the treatment of these in the ordinary way of refining, poling, and granulating, all the foreign matters other than gold, copper, and silver are removed, and by exposing the granulated metal to high oxidizing heat for a considerable time, the copper may be completely oxidized while the precious metals are unaltered. Subsequent treatment with sulphuric acid renders the copper soluble in water as sulphate, and the final residue contains only gold and silver, which is parted or refined in the ordinary way. This method of separating gold from copper, by converting the latter into oxide and sulphate, is also used at Oker in the Harz.

Chlorination Process.—Plattner suggested that the residues from certain mines at Reichenstein, in Silesia, should be treated with chlorine after the arsenical products had been extracted by roasting. The process, which depends upon the fact that chlorine acts rapidly upon gold, but does not attack ferric oxide, is now adopted in Grass Valley, California, where the waste minerals, principally pyrites from tailings have been worked for a considerable time by amalgamation.

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a Transactions of the New Zealand Institute, 1876.

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The roasting is conducted at a low temperature in some form of reverberatory furnace. Salt is added in the roasting to convert all the metals present, except iron, into chlorides. The auric chloride is, however, decomposed at the elevated temperature into finely-divided metallic gold, which is then readily attacked by the chlorine gas. The roasted mineral, slight moistened, is next introduced into a wooden vat, pitched inside, and furnished with a double bottom, as is shown in fig. 8. Chlorine is led from a suitable generator beneath the false bottom, and rises through the moistened ore, resting on a bed of broken quartz below the false bottom, converting the gold into a soluble chloride, which is afterwards removed by washing with water. The precious metal is then precipitated as metallic gold by sulphate of iron. The process has been greatly improved in America by Kustel, Deetken, and Hoffmann; with proper care it is a very perfect one, and yields 97 per cent of the gold originally present in the ore. It is stated not to cost more in California than 50s. a ton Any silver originally present in the ore is of course converted into chloride of silver and remains with the residue, from which it may be extracted by the solvent action of brine or by amalgamation.

GOLD IN CEYLON.

(From the *Ceylon Observer*, April 8, 1881.)

Extracts from a Paper read at the Royal Asiatic Society, Ceylon Branch, by Mr. A. C. Dixon, on Gold in Ceylon. The following are the main facts:—

There is a great similarity between the hill regions of Ceylon and the S. E. Wynaad district at the N. W. base of the Nilgiris, which has recently become so prominent an account of its auriferous reefs. As to the probable age of these districts we are uncertain, but there can be no doubt that the two regions are contemporaneous, consisting of granitoid schists or *gneissoid* rocks—that they are highly metamorphosed, and that quartz reefs form a conspicuous feature.

The reefs are often white, occasionally somewhat brecciated and not unfrequently bound together by *haematite* or *limonite*.

Although the strike of the rock is peculiar in the Nilgiris, E. N. E., yet the auriferous reefs run N. N. W. corresponding with the gneiss a little further to the north. The general run of the rocks is N. to N. W. As on the Wynaad we have an absence of intrusive rock. No dykes, porphyritic masses or basalts. It has been observed that the auriferous belts are richest where micaceous and chloratic rocks occur. Strange to say in the cuttings of the railway into our hill district and the various cuttings on the public roads no prominent reefs have been crossed; probably one or more may be met with in the extension of the railway from Nawalapitiya to Nanuoya. In several parts, the country is traversed by large persistent reefs of quartz with numerous narrow seams and veins diverging from them and often traceable into decomposed lithomargic earth. Some good examples of these are to be found in the Balangoda, Pussellawa, Ramboda and Dolosbage districts.

The character of the vegetation in prospecting for gold is of great assistance in Australia, where each formation is characterized by distinct forms of vegetation, but in Ceylon we have no guidance, at the mountainous zone, is but one formation. Gold occurs in three chief forms. 1, As scattered grains or nuggets on alluvial deposits, having been set free by natural causes from its matrix. 2, In grains and leaves on numerous veins, chiefly quartz. Still in the matrix but not with other metals: this is called *free* gold. 3, Associated (but not chemically combined) with numerous other metallic compounds, such as arsenides, sulphides, &c., generally classed under the term *pyrites*, found on veins of quartz and other rocks.

In the first form I have met with it in the alluvium of the Deduruoya beyond Kurunegala. The particles were exceedingly small and other metallic

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matters were not uncommon. This must have come from some quartz reef further up in the hills. Its occurrence on this river is referred to in the "Kadajurepattu."

A second instance of its occurrence in this form was in the Galle district, where a small nugget was taken from the alluvium accumulated in one of the ravines; it weighed over six grains, and was associated with fragments of gems, such as sapphire, garnet, chrysoberyl, tourmaline, &c., as well as of sulphides of some rare metals. This deposit was due to disintegration from the matrix in which they occurred originally. I followed up the ravine to its head with the expectation of finding quartz reef from which the gold must have been dislodged, and found two small reefs crossing the ravine. I took specimens from these and found traces of gold, but not in sufficient quantity to warrant its being worked. I have had further specimens from these reefs of a much better character.

In the second form it occurs in the Ramboda district, Central Province, where several remarkable reefs strike across the valleys.

In the third form it occurs in the pyrites of the gem-pits in the Ratnapura-Rakwana districts, but only in very small quantity.

From the little I have seen, it is my opinion that considerable quantities will yet be brought to light.

"GOLD IN CEYLON."

(From the *Ceylon Observer*, May 11, 1881.)

We may have to consider the propriety of taking a small contract for the supply of quartz to the breakwater if the present liberal receipt of rock-specimens from would-be gold-seekers continues! As a rule, however, the pieces which reach us do not afford a fair criterion of the quartz reefs, the specimens being taken from the surface. Among the acknowledgements we have to make are the following:—

A correspondent writes:—"Agra Patanas, May 1.—I herewith send per this post a sample of what, I suppose, is either metallic matter or gold amalgam, *i.e* a mixture of gold and quicksilver, found in the bank of a stream. There are traces of it all through, but it is confined more towards the source, where marks of working still exist. The Sinhalese must have had some object in view some years back or they wouldn't have laboured hereabouts. Please give me your candid opinion."

There is no gold in what our correspondent sends: the shining particles were pronounced by Mr. Macdonald Cameron to be all mica.

Another correspondent writes:—"Wallaha, May 2nd.—I have sent off to-day from here a small box containing a piece of quartz. Two pieces (small ones) wrapped up in paper have come off the same piece as sent, and seem to show decided signs of gold to the naked eye. Trusting it may turn out well."

We regret to say again that Mr. Macdonald Cameron pronounced against the chance of gold being found in this block of quartz: it is pyritous, the outer portion being marked by feldspar, but it is impossible to judge from the specimen sent of what the quartz reef proper may be like. The small piece sent is more promising, but it is iron pyrites rather than gold that glistens. Specimens of quartz to afford a fair idea of the quality of a reef should be taken from a depth of 8 or 10 feet, but planters would require to understand a little how to explore their ravines for the outcrop of a reef (not so much of a bed) of quartz and then to note accurately its dip and have it traced before proceeding to dig or blast for a sample.

"A Maskeliya correspondent writes:—

"I have a reef of quartz which, I would fain hope, is auriferous, though I fear it is more likely to be ferruginous! The quartz is dotted through with

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dark colored particles, which glitter when rubbed down with powder, a few of which I have pricked out, and enclose for your inspection and kind opinion. With thanks in anticipation."

Again we are sorry to say that the report is not favourable, although the sample is far too small, and from too near the surface, to enable a proper decision to be arrived at. The particles are micaceous. From Haputale we have:—

"Per to-day's post I send you two samples, one of quartz and one of sand. Do either of them contain gold, as I notice some yellow substance among them? I picked them up in one of the ravines on this estate."

These consist chiefly of mica. Again we have the following:—

"5th May 1881.

"DEAR SIR,—Evidently Ceylon must be simply teeming with gold, for I hear that the Sinhalese say Balangoda is the district famous in olden times for that precious metal. By to-day's post I send you a sample of what I believe to be iron-pyrites, which is, I am told a sure indication of gold. Is such the case?—Yours faithfully, W."

Our correspondent is correct in describing the sample as iron pyrites, which is common where there is but little of gold. At the same time the Balangoda, Ratnapura and Rakwana districts have long been reported to be rich in gold as well as gems. Of gold specimens found near Ratnapura, more anon. Meantime, perhaps the most promising specimens of quartz we have received so far are from Kirrara estate, Matale. Without being auriferous these are more like what experts wish to see in looking out for a promising quartz reef. But it is not likely planters can prospect to advantage without professional guidance or instruction. We are reprinting as fast as possible all the information given in the *Observer* during 1854 and 1869 on the subject, including a practical paper on "How to Find Gold," and the article on "Gold" from the latest number of the "Encyclopædia Britannica." All this will be a help to planting prospectors. We have also been enabled to use the reports of Mr. Saunders, when Assistant Agent at Ratnapura, in whose time gold dust and nuggets were found in some considerable quantity. Mr. Wm. Murray, an old Australian digger, then declared that the evidences were most satisfactory; *while Mr. Brough Smyth, to whom some of the gold was referred for report, expressed the opinion that the reef, the matrix, could not be far off, the gold having the appearance of not having travelled far.* The Government of the day, however, threw cold water on prospecting proposals, and nothing was done. We shall publish Mr. Saunders' interesting Reports in the *Observer*, and the Government Agent has also been good enough to leave with us a sample of the gold found on that occasion which can be seen at the *Observer* Office:—a veritable proof that there is "GOLD IN CEYLON."

THE DIAMOND DRILL AND THE EARTH SCOOP.

We have received from Melbourne papers referring to these two labour-saving appliances. The paper referring to the diamond drill is printed in the form of a poster, being addressed "to the mining community" by the Bendigo School of Mines and Industries. It contains sketch sections, and patterns of diamond drills, with accompanying letterpress. Figure 1 represents a bore sunk in the Bendigo district to the depth of 825 feet, passing through alternate strata of sandstone and quartz, gold having been struck at 390, 512, 606, and 706 feet. The result of this has been to send up the shares of the Company (G. G. Consolidated) from 6d to 8s 3d. The drill employed was one which could operate only from the surface: if it could have been taken into the mine to work from the lower levels the results would have been much more important. This is being done in America, and figure 2 gives an illustration of such workings at Silver Islet, Michigan, where the drill occupy

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ing only 7 feet by 6 feet was lowered to the eighth level (488 feet), and experimental holes were bored in all directions, thus yielding information as to the contents of the mine which could not otherwise have been obtained without years of labour. The machine used in this case bored three thousand feet in six months, the only repairs needed at the end of that time being trifling. Well, therefore, may Mr. Bayne, the President of the Bendigo School of Mines, say:—

"As a prospecting tool then, the Diamond Drill is quite unique, and accomplishes results that can be obtained by no other known process. It should be remembered at the same time that it is a scientific instrument and not a divining rod. It must be used with discretion, and its indications read intelligently. It does not point by some inscrutable agency to payable reefs, but it tells us with great certainty and with remarkable expedition whether we shall come to auriferous quartz if we dig down or along a certain direction within the 2,000 feet or more. A negative answer saves the trouble and expense of sinking or driving in that direction, and we have then only to put further questions by varying the direction of the line of search. Their use enables a larger amount of work to be performed and thereby increases the demand for labour, and it is to be noted that in the States where these drills find such favour, the price of labour reaches from 10s. to 15s. a day, showing that the drill recommends itself as much to the miner as to his employer. At the Great Northern Company, Stawell, Victoria, where one of these underground drills is now at work, in 60 shifts of 8 hours each, or 480 hours, between April 27th, and July 5th, 1880, it has bored through 483 feet 3 inches, commencing at a depth of 800 feet.. This is looked upon as very satisfactory, considering the hardness of the stone, a sample of which may be seen at the School of Mines, Sandhurst."

An extract from the *Scientific American* of 28th Feb. 1880 states that "Mr. A. J. Severance, of San Francisco, says that the Diamond Drill has played a very important part in developing the mineral wealth of the West. The first great treasure-house which these drills opened up was that known as the Consolidated Virginia, and the California Bonanzas, which have yielded Twenty-two million two hundred and ninety one thousand pounds sterling, of which the stock-brokers have received Fifteen million four hundred and sixteen thousand pounds sterling, in dividends. One of the owners of the mine told Mr. Severance that the Diamond Drill had realised for him One million pounds sterling. All the principal Comstock mines, and many of the largest mining properties located in California and Nevada, use these drills. They are also extensively used in Colorado, have pushed their way to most of the Territories, have been introduced and operated in New Mexico, Old Mexico and Australia. The Japanese Government has also been supplied with them. Mr. Severance enjoys the distinction of having perfected the Diamond Drill, and of proving its utility by running a horizontal hole (then regarded an impossibility) eight hundred feet, taking out a complete cylindrical core, and showing the strata of every inch of rock passed through. This was done in Vermont. Soon after he introduced the drill upon the Pacific Coast, with the results already noted."

Figures 3 and 4 show the tunnel and mining drill and the open cut and quarry drill respectively. The former when set up weighs about 300 lb., the size of the bit is 1¼ in. diameter, and the price £261; the latter weighs 250 lb., size of bit 1 to 1¾ in. diameter, price £209. These drills might be useful in Ceylon not only for gold prospecting but perhaps for sinking wells in the drier parts of the island. This brings us to the "patent wheel earth scoop," manufactured by Messrs. Robinson & Sons of Melbourne, for making dams and tanks to retain rain water. The prospectus states that "It is as simple as it is possible to be made. It is very strong, being made nearly wholly of wrought iron, so that there is little chance of its breaking. The draught is onl half tha required for skid scoop of equal size, besides being

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much handier and easier for the man (who can both drive the team and work the scoop,) it does the work in far less time, as being on wheels it enables the team to travel much faster than with a skid scoop. The prices given range from £14 upwards. The principle of the scoop appears to be the same as that of the Elder steam scoop, regarding which we quoted a paragraph from the *Sydney Mail* in our issue of 26th February last.

GOLD IN CEYLON.

Further Official Reports on the Exploration and Digging in 1854

No. 123. Colombo, 14th March, 1854.

The Hon'ble the Colonial Secretary, Colombo.

Sir,—I have the honor to report for the information of His Excellency the Governor, that being on a visit to the spot to which the recent discovery of gold by some sailors has drawn attention, I am enabled from a personal inspection to confirm the fact of the discovery.

The situation of the place of operations is the rocky bed of the Maha Oya about five miles north of Weweldeniya, between the 31st and 32nd mile-stones on the Kandy road, and about an equal distance from Giriole and Ambepussa, and adjacent to the Kale Gampola Udugaha Korale of the Kurunegala district and the Udugaha Pattu of the Hapitigam Korale of the district of Colombo.

The Maha Oya, which has a north-westerly direction up to this point, takes here a nearly direct northerly sweep, and during the dry season exposes a much broader expanse of bed than at any other part immediately above or below it.

The broken surface, on the eastern side principally, is occupied with a mass of debris probably washed from either bank, which is found to give cover to other disintegrating masses, which may belong either to the rock overlaid or to the superincumbent deposits.

The resemblance of this bank to places in which some of the party of sailors had witnessed the successful search for gold elsewhere, appears to have attracted them and to have induced them to conduct their experiments here with results which have in some degree served to unsettle the public mind.

From all I have been able to gather, the quantity of gold collected from the date of the first experiment on the 2nd instant, does not exceed one ounce, and probably does not amount to so much.

The washing of about eighteen buckets of soil, weighing about 8 cwts. in my presence, only yielded half a grain of gold, and I find in a passage in Dr. Ure's Dictionary of Arts that veins which yield 10 or 11 grains of gold in a cwt. would scarcely defray the expense of working.

The nature of the soil, however, is such as is generally known to be gold-yielding, and though I am not sanguine that the precious metal will be found in sufficient abundance to reward the exploitation, I think every encouragement is due to such persons as are disposed to prosecute the search, and have accordingly just allowed a second party of sailors to choose for themselves another place of trial, the traces of gold according to the report of the first explorers not being confined to this locality, but being met with at other parts of the Maha Oya, of which a bar about 1½ miles lower down the stream, and another ¾ of a mile immediately above the present occupation have been mentioned as instances.

Dr. Ure states that Reaumur had remarked that the sand which more immediately accompanies the gold spangle in most rivers, and more particularly in the Rhine and Rhone was composed, like that of Ceylon and Expailly, of black protoxide of iron and small grains of rubies, corundum, hyacynth, &c.

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The correctness of this observation with respect to Ceylon is borne out by the appearances presented during the process of washing here, the residuum, after the separation of the coarser components of the soil being invariably a black sand with an admixture of minute gems and spangles of gold.

Having assisted the sailors in constructing an embarkment for the purpose of facilitating their operations by obtaining a flow of water at a higher level than they can at present command,

I shall await the conclusion of an experiment made under more favourable circumstances to communicate again with Government.

I have, &c.,

(Signed) C. P. LAYARD, Govt. Agent.

No. 124. Colombo, 15th March, 1854.

SIR,—With reference to my letter of the 14th instant from Talagama in the Hapitigam Korle, and finding that the permission granted by me to certain sailors to dig for gold in anticipation of the authority of Government would have been inconsistent with His Excellency's minute of the same date which I had not then seen, I have the satisfaction to report that that permission was not availed of by the parties to whom it was granted.

I have, &c.,

(Signed) C. P. LAYARD, Govt. Agent.

FURTHER REPORT ON THE GOLD DISCOVERY OF 1868.

No. 818. Government Agent's Office, Colombo, 18th Dec., 1868.

SIR,—In submitting the accompanying copy of a letter from my Assistant at Ratnapura, dated the 16th instant, I have the honor to recommend a compliance with Mr. Home's request to the extent that Government should procure for him under the provisions of the Ordinance No. 2 of 1863 any private land which he is unable by private arrangement to acquire for the purposes of his research, on his making full payment of its value.

With respect to the reward to be offered for the discovery of gold in remunerating quantities, I think that as well as the condition on which the right of working gold fields should be conceded to Mr. Home and others in the event of their being found to exist, may be a matter for after consideration.

I am of opinion that the exclusive privilege of searching for gold within a radius of two miles from the point where the traces of the precious metal have been already found, cannot be reasonably conceded.

I have, &c.,

(Signed) C. P. LAYARD, Govt. Agent.

The Hon'ble the Colonial Secretary.

GEOLOGY AND MINERALOGY OF CEYLON.

(*From Pridham's "Ceylon."*)

In Ceylon there is not that order and succession of rocks to be found as in England and other parts of Europe. Uniformity of formation is the distinguishing characteristic of the geological character of the island, and with but few and partial exceptions, such as at Jaffna and the contiguous islets, and here and there along the shore about high water mark, it may be said to consist of primitive rock, and unconnected with any other class of rock, exclusive of those of very recent formation.

Another remarkable geological fact is, that though the varieties of primitive rock are extremely numerous, and indeed almost infinite, the species are very

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few, and seldom well defined. The most prevailing species are granite or gneiss; the less frequent are quartz-rock, hornblende rock, and dolomite rock, which may be classed under the head of imbedded minerals.

The varieties of granite and gneiss are endless, passing often from one into another and at times losing their character by the transition, and assuming appearances for which, in small masses, there would be a difficulty in finding appropriate names. These mutations and remarkable variations are traceable chiefly to composition, the proportions of the elements, excess or deficiency of one or more, or on the addition of new ingredients. Nor should mechanical structure, variation in which, though hardly palpable in reference to causes, has an evident effect in regulating appearances, be omitted. Regular granite is rare; where found it is generally of a grey colour and fine grained. Graphic granite is still rarer. The quartz, where it is found, is black or grey rock crystal, and the felspar highly crystalline and of a bright flesh colour. The quartz envelopes the felspar in very thin hexagonal or triagonal cases, so that nothing can more vary in appearance than the longitudinal and transverse fracture of the rock.. Petrifactions of wood, combining quartz and felspar, have been occasionally found in the interior. This is a mineralogical novelty, the latter substance never having been found in petrifactions of a similar nature.

Moonstone has also been found embodied in porphyric rocks in large masses, and is more beautiful than moonstone hitherto dug from rocks of decomposed white clay. Sienite is uncommon. It occurs in the interior, rather forming a part of rocks of a different kind than in great mountain masses.

Well formed gneiss is more abundant than granite. Its peculiar structure may be seen in many places, but no where so clearly as at Amanapoora in the Central Province, where it consists of white felspar and quartz in a finely crystalline state, with layers of black mica, containing, disseminated through it, numerous crystals of a light-coloured garnet. Both the granite and gniess are very much qualified by an excess or deficiency of one or other of the ingredients. When quartz abounds in a fine granular state, the rock often looks very like sandstone; of this there is an instance in the vicinity of Kandy. When felspar or adularia abound, the rock acquires a new external character: this variety is common. In a few places the rock contains so much of these minerals that it might be correctly called adularia, or felspar rock. When mica prevails in gneiss, which in Ceylon is very rare, it acquires not only the appearance, but very much the structure of mica slate. The instances of change of appearance in the granitic varieties from the presence of unusual ingredients, are neither few in number nor unfrequent in occurrence.

The more limited varieties of primitive rock, as quartz, hornblende, and dolomite rock, seldom occur in the form of mountain masses. Quartz is found in some places so abundantly in granite rocks as even to rival mountain masses. It is generally quite bare, and stands erect like denuded veins. From its precipitousness it often exhibits the appearance of buildings in ruins. The quartz is in general milk-white, translucent, full of rents, and so very friable as to resemble unannealed glass. Pure hornblende rock and primitive greenstone are not uncommon, and though they constitute no entire mountain, form a part of many, particularly of Samanala and the Kandyan mountains.

Dolomite rock is almost entirely confined to the interior, where it is found in veins and imbedded, and sometimes constitutes low hills. The varieties of dolomite rock are almost as numerous as those of granite. When purest it is snow-white, generally crystalline, composed of rhombs that are easily separated by a blow, but rarely finely granular. When highly crystalline it is composed of about 56 of carbonate of magnesia, 36·9 carbonate of lime, 4·1 alumina, 1 silica, 2 water. A very fine granular kind is found, but it is so uncommon, that it was appropriated under the Kandyan dynasty to the sole use of the king. The great variety of this rock arises both from the proportion of carbonate of lime and of magnesia

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being seldom the same, and from the commixture of other minerals. The varieties most frequent are mixtures of dolomite with felspar and mica, and even quartz. It is from the purer kinds of dolomite rock that all the lime employed in building in the interior is procured. The presence of magnesia injures its qualities as a cement; but though inferior in this respect to the lime from shell and coral, it answers sufficiently well for ordinary uses.

In external character and general structure, the varieties of primitive rock exhibit fewer marked differences than might have been expected. The masses that are exposed, are generally rounded, seldom rising to craggy points or appearing in grotesque shapes. The nature of the rock may often be surmised, from its external appearance, but generally cannot be precisely determined but by an examination of a recently fractured surface. In structure the granitic varieties most commonly exhibit an appearance of stratification, but is not easy to decide positively whether this appearance is to be attributed to the mass being composed of strata or of large laminæ or layers. Some great masses of insulated rock, several hundred feet in height, exhibit incontrovertible proofs of this structure. In these the same layer may be seen extending over the rock, like the coat of an onion, and which if but partially exposed, might be adduced as a strong proof of stratification, and if examined in different places on the top and at each side, might be deemed an extraordinary instance of the dip of the strata in opposite directions. With this hypothesis of the structure of the rocks, the appearance of stratification in all the granitic varieties may be easily reconciled.

Rocks of recent formation are of two kinds, limestone and sandstone. The first is said to be confined to the province of Jaffna, the most productive and populous district of Ceylon, which is an extended level plain without a single hill or valley, and contains numerous decomposed shells, and other marine productions; it is generally grey or light brown, very fine grained and compact, and breaks with a conchoidal fracture. It is generally nearly a pure carbonate of lime, affording but slight traces of the presence of vegetable or animal matter, and containing a little water. Where it occurs, the whole of the country is similar, and elevated but a few feet above the surface of the sea, by which it was once probably covered. The recession of the sea from this district is even now going on, many natives recollecting the waves covering spots now far above high-water mark. It is proved also from the fact of coral rock being found mixed with the limestone rock several miles from the sea. Minute inquiry on the spot might elicit some valuable information on the formation of this rock, which is still probably extending in the shallows of the adjoining seas, and along the coasts of Jaffnapatam. Its formation may possibly be connected with coral, which is so abundant in the narrow seas between Ceylon and the Indian Peninsula, that most, if not all, of the islets in the strait are composed of it, and the gradual increase of coralline in the waters near these shores proves the natural and steady encroachment of the land. The only difficulty is, to find the cause of the solution of calcareous matter in some places, and its precipitation in others adjoining.

Sandstone, the other rock belonging to the recent formation, may be considered to surround the island with an almost uninterrupted chain. It exhibits in every part the same general character, and is found under the same circumstances, in horizontal beds along the shore, chiefly between high and low water mark, which in Ceylon, where the tide rises only about three feet in perpendicular height, is a very limited extent. In shallow water, it may extend perhaps farther into the sea. Towards the land, it does not extend beyond the beach. A remarkable instance of this is found on the north side of the Kelaniganga. In width the bed varies from a few to fifty or even a hundred feet. Towards the sea, it presents a bold face, above twelve feet deep, perpendicular like a wall, over which the waves break, and which, when the sea runs high, as it does on this shore, a great part of the year is completely under water. On

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the other side, towards the land, the rock commonly terminates in sand, the beach generally rising above it. This bed is in most places distinctly stratified, and where the strata are not deranged by fractures and subsidences, they are quite horizontal. The appearance of the rock is not uniform: its principal varieties are a yellowish-grey sandstone, another almost black, and a third of the first kind, but containing nodules of the latter. These varieties occur in the same stratum, and a vertical section often exhibits successive layers of the two first kinds. They all consist of sand agglutinated by carbonate of lime, which, from its texture, appears to have been deposited from water. Thus the stone crumbles to pieces, and is reduced to sand when heated before the blow-pipe or immersed in an acid. The proportion of carbonate of lime is variable, being from 26·5 to 11 per cent. The larger the proportion, the harder is the sandstone; thus the last-mentioned is soft and taken from a depth in an incipient state of formation, while the former is taken from the surface, is completely formed and extremely hard. Irrespectively of the proportion of carbonate of lime, the sand of which the stone is formed, is of different kinds. The sand of the light-coloured variety is chiefly silicious, consisting of fine water-worn particles of quartz, like the sand of the shore, and like it, it occasionally contains shells and pebbles. The sand of the variety nearly black, is a mixture of silicious particles, and of particles of iron glance becoming magnetic by wasting. It is extremely hard, the iron no doubt acting the part of a cement, as well as the carbonate of lime.

The question of the formation of the sandstone is involved in much of the same obscurity as that of the limestone of Jaffnapatam, and the same conjectures might be offered respecting the probable cause of the deposit of the calcareous cement. This instance of the formation of rock from the dissolved and disintegrated materials of old rocks is not peculiar to Ceylon, as it is quite as common as those of decomposition itself. Both the limestone and sandstone of this recent formation may become very useful. Very good lime may be made of the former, and serviceable millstones, perhaps of the latter, if it can be found, as is very probable, of a coarse quality. For architectural purposes both stones are well adapted, more especially the sandstone for great public works, as it may be wrought at little expense, and when the wind blows off the land may be easily shipped.

Mineralogy.

The mineralogy of Ceylon, is, in some respects, remarkable and curious. The island is remarkable for its richness in gems, and, so far as has yet been ascertained for its comparative poverty in the useful metals. It is remarkable also for the number of rare minerals that it affords, and for the small variety of the ordinary species: thus in its mineralogical character, it accorded with the taste of its late native rulers, who were more prone to display than any work of utility, to pomp than profit. Its mineral productions may be classed under two heads, those attached to granitic, which constitute the greater part, and those pertaining to dolomite rock. The only metallic ores that can be hitherto said to be found in any quantity deserving of notice, are of iron and manganese. Iron in different forms is pretty generally diffused, and somewhat abundant. Iron pyrites, magnetic iron ore, specular iron ore, red hematite, bog-iron ore, and earthy blue phosphate of iron are all found. Red hematite and bog-iron ore are more common than the other species. It is from these ores that the natives extract the metal. With the exception of iron pyrites, magnetic ironstone and the blue phosphate, the species of iron occur so frequently in granitic rock or its detritus, as not to require notice. The first, iron pyrites, is found at Ratnapura, disseminated through a grey felspar rock, and in veins of quartz at Mount Lavina on the sea shore. Magnetic iron ore, is found in masses, imbedded in gneiss in the vicinity of Kandy and in granitic rocks in Wellassa and Trincomalee. The earthy blue phosphate of iron is procurable from a marshy ground near Colombo, and from a bed of bog-iron ore near Kandy. It is said to be used by the natives as a pigment.

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It is to be observed *that no great bed, and that no considerable vein of iron ore has yet been found in Ceylon*; though we must remark that a full half* of the island is comparatively speaking a terra incognita to the Europeans in Ceylon capable of investigating it. No foundry on an extensive scale could then, judging from present appearances, be established with success. To the natives it may possibly be worth while to collect scattered masses of ore for their little furnaces, but unless an extensive bed or vein of ore be found, the attempt to establish a foundry would be idle. Iron is melted by the natives in crucibles, over a fire which is blown with two bellows. The scoria is separated from it with tongs made expressly for the purpose, and the melted mass poured into a mould of clay, after which it is purified further, and forged for smaller uses. But one ore of manganese, the grey or the black oxide, is yet known in Ceylon, and that occurs in parts of Saffragam and Upper Uva. Like most of the ores of iron it occurs finely disseminated and imbedded in small masses in granitic rock; some specimens are pure, and in some places a considerable quantity might be collected. Hitherto it has been applied to no useful purpose, nor from its locale and dispersed state is it likely to be exported with profit.

From the nature of the rocks, other metals might have been expected in Ceylon, says a learned geologist, who mentions that he has sought in vain among the mountains for tin, copper, and lead. All three, however, are reported to exist by persons who have themselves discovered them, and quicksilver and plumbago (kalu miniran, *Singh.*) which of late years has been largely exported to England, may be added to the list. Gold and mercury, which are said to occur native in Ceylon, according to this writer are rarely found, but small lumps of the former have been at times met with. "Did any," he continues, "of the common, and what is more, of the precious metals occur in Ceylon it would have been known long ago; for the natives are inquisitive and curious, and being in the habit of searching for gems, and collecting everything that glitters, or that is in the least likely to sell, even bits of iron pyrites and ores of iron, it would be very extraordinary were they to pass unnoticed substances more attractive, with the value of which they are well acquainted." I may cursorily observe that this remark is rather applicable to the natives of the southern, than any of the other provinces of Ceylon, and that the opposite conclusion of another learned geologist, embodied in the note,† is nearer the truth. Dr. Davy's erroneous conclusion on these points must have arisen from the imperfect opportunities at his disposal for the survey of the whole island, not more than one-third of which he ever visited, and not from any want of sagacity in observing, or ardour in pursuing the various branches of natural science. Stahlstein, or crystallized pyrites, impregnated with a little copper, is used by the Singhalese for making buttons.

Most of the gems for which Ceylon is celebrated, occur in granitic rock; for though found in alluvial soil and the beds of rivers, their true source may

* Coal is said to have been discovered in the island by the Dutch; but from the abundance of wood, and charcoal being the only fuel used by the native cooks, no notice was taken of the discovery, so that its habitat is now unknown. The discovery of coal would now be considered one of the greatest acquisitions of which this favoured land could boast. It is not at all improbable that it exists in parts of the scarcely explored districts in the north, where I venture to perdict the mineral wealth of Ceylon will be found to lie.

† The sciences of geology, mineralogy, &c., in all their branches are but imperfectly understood by the natives, notwithstanding Ceylon is the depository of such an extensive variety of specimens. Their attention seems never to have extended much beyond the valuable gems and the common ores. As to a thousand other objects, both on the surface of the earth and imbedded in the hidden substrata of nature, so interesting to men of science, they have allowed them an almost undisturbed repose, never having exerted themselves either to quarry out a knowledge of their latent properties or ascertain their intrinsic worth.

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be conjectured from the nature of the surrounding rocks and the quality of the sand and alluvium in which they are found. The minerals pertaining to this rock are of the quartz family, quartz, iron flint, chalcedony and hyalite. Ceylon affords all the varieties of quartz, as rock-crystal, amethyst, rose-quartz, cat's-eye, and prase. Rock-crystal occurs in abundance, both massive and crystallized, of various colours, good quality and in large masses. Its localities do not need noticing. Buttons are made of it. The black crystal is of a shining fracture, and falls into slate-like shivers, which are transparent at the edges. It possesses electrical properties. The natives use it instead of glass for the lenses of spectacles; they employ it too for ornamental purposes and statuary. In the Mahawihara, in Kandy, there is a small well-executed figure of Buddha of this stone. Amethyst (Skuandi, *Singh*,) also is pretty abundant; very beautiful specimens of this mineral are found in the alluvium derived from the decomposition of gneiss and granitic rock in Saffragam and the seven Korales. The largest specimens are cut for buttons, and the smaller for a smaller-sized button. The more saturated the colour is in them, the riper they are. They were probably once in a fluid state, and previous to their crystallization were tinged with a violet colour, which incorporated itself with a part or else with the whole of the fluid. It is of a purple violet colour, differing much in the degrees in which they are coloured. Some are so saturated as to appear almost black. They seldom reach the size of a walnut; the larger they are the paler, and less esteemed. Crystals of it, containing apparently two distinct drops of water, have been found. Rose-quartz, which is pretty common, is often found in the same place as amethyst.

Ceylon produces the finest cat's-eyes (Wairodi, *Singh*.) in the world; indeed, the only kind that is highly esteemed and that brings a high price. The best specimens of this singular mineral have been found in the granitic alluvium of Saffragam and Matura. It is a hard stone, approaching more or less to white or green, semi-diaphanous, with a streak of the breadth of a line in the middle, whiter than the stone itself, and throws its light to the side that it is turned. It is a pseudo-opal, averaging the size of a hazel nut. Prase is a variety of quartz that seldom occurs in the island. The second species, iron-flint, is not uncommon in the Central Province, Saffragam, and Lower Uva. Some varieties of it much resemble hornstone. The third species, chalcedony, undoubtedly exists somewhere in the mountains of the interior, as fragments of it have been observed in the possession of the natives. The fourth species, hyalite, is extremely rare, being met with only in a nitre cave in Dumbera, partially encrusting a granitic rock.

Belonging to the schorl family are two species, the topaz and schorl (Purperagan, *Singh*.). The former is generally known as the white or water sapphire. It is commonly white, or bluish, or yellowish white; much waterworn, and perfect crystals of it are very rare. It occurs in many places in the alluvium of granitic rock, about the size of a large nut, and is clearer than white crystal. Schorl is not abundant; common schorl is perhaps an exception, it is to be seen in many places in the granitic rocks, and in places in Lower Uva, mixed with quartz and felspar, it constitutes a rock of considerable magnitude. Tourmaline is rare, and the common varieties of green (patje turemali), a name given both to chrysolites with tetraedal prisms, and even sometimes to the chrysoprasi. It is often opaque, and various shades, bordering on yellow, blue, and black, are classed under it; honey yellow (kaneke turemali), is a topaz of a greenish yellow in appearance, resembling amber; some are more saturated and ripe, almost of an orange colour. Red (pana turemali), is a quartz; when laid on a table it appears opaque; held to the light it has a pale red hue. They vary in size from a grain of rice to a pea. They are seldom crystallized, and most of them are worn smooth and polished from the action of the water. Blue (neela turemali), is a quartz; white (sudu turemali), is a topaz of a pale yellow called the Matura diamond. It is not perfectly transparent; for this reason, it is often calcined in the fire, which has an effect on the colour; but

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the stone is made clearer. It is then enveloped in fine lime and burned with rice chaff. It is cut for setting in rings, &c. With the exception of the last, most of these are of an indifferent quality, and their locality is unknown. Some writers have maintained that both the emerald and beryl are found in Ceylon. The former, says Davy, is certainly not found, and there is much doubt as to the existence of the latter, most of those offered for sale being imported; and those said to be found in the island being improperly so, as affording an excuse for a higher price than that asked for those of the continent, which are contemptuously called "coast stones."

Of the garnet family three species occur in gneiss or granitic rock, viz., the garnet, pyrope, and cinnamon stone. The common garnet is abundantly disseminated through gneiss in almost every part of the country. Its crystals are in general indistinct, small, contain a large proportion of iron, and are very apt to decompose. The best and most perfect crystals of this mineral are in quartz rock. The precious garnet occurs but in few places, and not in first-rate quality. It is contained in hornblende rock at Trincomalee.

Cinnamon stone, though an abundant mineral in this island, to which it exclusively pertains, is found only in a few places, and chiefly in the Matura district. It occurs in granitic alluvium in small irregularly shaped pieces, and in large masses of several pounds weight. Near Belligam a large detached rock is partly composed of this mineral; the other ingredients of the rock are felspar, tablespar, quartz, hornblende, and graphite. "The thick jungle," says Dr. Davy, "round the spot where this interesting rock stands, prevents a minute examination of the neighbouring country;" but his opinion seems to be that this rock had been detached from a vein or bed included in gneiss or granitic rock in the hill above. Another mineral of a doubtful nature, disseminated in small masses, occurs in many places, as at Colombo, Mount Lavinia, &c. It is semi-transparent, and never crystallized, and has the fracture and lustre of cinnamon-stone. It certainly belongs to the garnet family, and is probably merely a variety of cinnamon stone; from which it appears to differ chiefly in being of a redder hue, and in this respect approaches pyrope.

The zircon family is richer in Ceylon than in any other part of the world. It is chiefly confined to the districts of Matura and Saffragam, more especially to the former, and is indicated by the popular name 'Matura diamond,' which is applied to its finest varieties by the dealers in gems. Besides the well known species, common zircon and hyacinth, a third species, massive, opaque, uncrystallized, and of a dark brown colour, some specimens of which, from Saffragam, have been known to weigh two or three ounces, has been also found. The natives are completely ignorant of the true nature of zircon. The yellow varieties are sold by them as a peculiar kind of topaz; the green as tourmaline; the red hyacinth as inferior rubies; and the very light grey as imperfect diamonds. All the varieties on sale are found in the beds of rivers, or in alluvial ground derived from the decomposition of gneiss or granitic rock. It is to be seen, however, in its original site in these districts sparingly disseminated through quartz and schorl rocks, or quartz and felspar with tablespar and graphite. The zircon in some parts of the mass so largely preponderates as almost to entitle the rock to be called zircon rock. The mineral in such a case is crystalline, and most commonly green or brown; the rock is remarkable for its heaviness, and for the resinous lustre of its fracture.

For the ruby family (Lankarettè *Singh.*), Ceylon is no less celebrated. Four species of it, spinel, sapphire, corundum, and chrysoberyl occur in gneiss or granitic rock. Spinell is comparatively rare, though there are some small and most beautiful crystals of it found in the interior, and it is found in specimens of clay iron-ore in parts of the Central Provinee, where gneiss prevails. Sapphire is common though widely scattered; it occurs in great perfection and in considerable abundance and magnitude in the granitic alluvium of Matura and Saffragam, and about Nuwara Eliya; the principal varieties being the blue, purple, red, yellow, white and star-stone. Barbosa remarks that the Singhalese in his

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day bleached sapphires in such perfection, that they might be taken for the finest diamonds. Fragments of blue sapphire of indifferent quality have been found as large as a goose's egg. The purple variety or the oriental amethyst is rare. A green variety is still rarer, and when found, perhaps, owes its colour to a blending of blue and yellow, two colours of frequent occurrence in the same stone. The black sapphire is no less rare. It is not uncommon to find some other mineral included in the substance of the sapphire, such as crystals of iron glance, or a small mass of crystallized mica. Corundum is less frequently met with than the sapphire, being rarely, found except in Uva, where it is found in the bed and in the banks of a small stream; the sand, gravel, and pebbles among which the corundum occurs, in their nature correspond with varieties of granite, gneiss and hornblende rock. The corundum is often found in large six-sided prisms, it is commonly of a brown colour, whence it is called by the natives koroondu gala (cinnamon stone). Occasionally it is to be met with partially or entirely covered with a black crust, perhaps merely the stone with an unusual proportion of iron. The corundum and sapphire are so closely akin, that the natives have even observed the similarity. The two minerals are linked together by the coarse and opaque varieties of the latter, which are common enough in Saffragam. Chrysoberyl is of very rare occurrence, and is said to be brought from Saffragam. The more perfect crystals of all the varieties of ruby, sapphire, corundum and chrysoberyl, exhibiting in every direction smooth facets like the garnet, the diamond, and so many other minerals, seem to shew that they are contemporaneous in their formation with the rock from whence they are derived; that they have crystallized in its substance; and that they are not detached till it undergoes distinegration or decomposition, when they are washed by the heavy rains and torrents with the detritus of their parent rock to lower ground to reward the perseverance of the native explorers who might search in vain in the mountain mass. Corundum is the only species of this family that is not esteemed as a gem, and the only one that is applied to any purpose of utility. In its powdered state it is extensively employed by the lapidary in cutting and polishing stones, and by the armourer in polishing arms. It enters, too, into the compositions of an excellent hone made by natives, consisting chiefly of this mineral in very fine powder, and of kapitia a peculiar kind of resin.

Of the felspar family, it is highly probable that several species exist in the island. Tablespar has been already alluded to, and the subdivisions of felspar *viz*, adularia (including glassy felspar), Labrador-stone, common felspar, and compact felspar. These minerals are common in gneiss and granitic rock, with the exception of Labrador stone, which is seldom found, and then in a bed of graphic granite. Adularia is very abundant in some parts of the interior, particularly in the neighbourhood of Kandy, where it is occasionally the predominating ingredient of the rock.

Of the hornblende family, two species occur, common hornblende, the constituent of the rock of this name and glassy tremolite which has been observed at Trincomalee in a narrow vein of quartz in gneiss.

Pitchstone is perhaps the only mineral of the family of this name to be found in Ceylon, a small vein of it occurs near Trincomalee in granite. Mica or glimmer (Miniran, *Singh.*), as a constituent part of granite and gneiss is abundant, besides, it often occurs in large plates imbedded in these rocks. It is collected by the natives, who use it for purposes of ordinary decoration, and for ornamenting talipot parapluies. Common chlorite is occasionally to be met with both at Galle and Trincomalee disseminated through quartz. Green earth is more rare; it is found in Lower Uva, where it is pretty abundant near Alipoot in small veins, and includes masses in clay derived from the decomposition of a granitic rock. This mineral is of an unusually light colour, varying from green to light apple-green.

Magnesian minerals are far from abundant in Ceylon, and are perhaps confined to dolomite, carbonate of magnesia, and talc. The very rare mineral native carbonate of magnesia, has been discovered in a nitre cave, accom-

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panied with dolomite and encrusting and included in gneiss. The best specimens of it were of a pure snow-white, earthy texture, rather harsh to the touch, destitute of smell when breathed on, and not adhesive. A specimen of it, examined by Dr. Davy, contained 86 carbonate of magnesia, 5 water, 9 silica, with some slight traces of carbonate of lime.

This mineral is perhaps co-temporary with the rock in which it occurs, and not deposited subsequently from water. It has long been used by the natives of the adjoining country in whitewashing their temples. Talc is very rare in Ceylon. It has been met with at Dumbara in a nitre cave, where, with calcspar, felspar and quartz, it entered into the composition of a highly crystalline rock.

Calcspar, anhydrous gypsum, and calcsinter are the only pure calcareous minerals to be found in Ceylon. The two former, well crystallised, have been met with at Dumbara nitre cave. They occur in the compound rock just alluded to in reference to talc. Calcsinter is not uncommon; encrusting rocks of dolomite and gneiss, it abounds in Matale, and is plentiful in Lower Uva and in many places in the vicinity of dolomite rock, from which in all probability it is derived.

There are two kinds of the inflammable class of minerals that occur in Ceylon, graphite and sulphur. Graphite in minute scales is very commonly disseminated through gneiss, and it occasionally occurs imbedded in this rock in small masses. In the latter form, it is found to some extent in parts of Upper Saffragam, and might probably be found in sufficient quantity to be collected and exported profitably. Sulphur is extremely rare in Ceylon, indeed its very existence is not indisputably proved. A specimen of this mineral was some time ago picked up in Dumbara, which contained a large portion of sulphate, a small portion of sulphate of iron, and slight traces of alum. The stone itself was composed chiefly of quartz, felspar and oxide of iron, and of some grey crystalline grains. Had the specimen been broken from a rock, little room for doubt would have remained, but even as the case stood, it appeared more likely to be native sulphur than an artificial accidental impregnation, for which indeed it would be almost impossible to account. The mineral productions occurring in the dolomite rock are of two kinds, those peculiar to it and hitherto found in no other rock in Ceylon, and those common to it and to granitic rock. Belonging to the latter, the following minerals may be enumerated:—Iron pyrites, mica, white clay, probably derived from the decomposition of felspar and graphite. With the exception of mica, none of these minerals are common or abundant in dolomite. The mica is generally of a light brown or straw-colour, translucent and crystallised in small six-sided prisms. The minerals peculiar to dolomite are three in number, Ceylanite, apatite and a bright yellow mineral, perhaps a variety of cinnamon-stone. Ceylanite is pretty abundant in this rock, and very generally disseminated through it. It occurs crystallized and amorphous, and exhibits a variety of colours, as bright azure-blue, resembling the blue sapphire, violet, pink-red, grey and white. Its crystals are generally very small. The fine sapphire blue Ceylanite is almost confined to one locality. Of the pink-red, some good specimens have been met with from a vein of dolomite in Saffragam, on the banks of a stream that flows into the Kalu-ganga. Ceylanite of the other colours is common particularly in the dolomite rock near Kandy and Badulla, where it generally occurs amorphous, or very indistinctly crystallised. Apatite, of a bright sapphire-blue colour, is frequently to be seen in dolomite, disseminated in very minute particles. It occurs in one place well crystallised, in six-sided prisms in a few places. The bright yellow mineral, perhaps, a variety of the cinnamon-stone, which it resembles in its general properties, and has never been seen crystallished, is not uncommon in dolomite in the vicinity of Kandy. This result is difficult to ascertain from the small particles in which it is found. Though, then, the number of minerals hitherto found in dolomite rock is

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small, it is highly probable more may yet be found to reward the mineralogist, who may search in the quarries of the interior, where it is broken for making lime.

SKETCH OF THE GEOLOGY OF CEYLON:

BY GEORGE GARDNER, F. L. S.

(From "*Ribeyro's Ceylon,*" *by George Lee.*)

The island of Ceylon appears, at an early period of its physical history, to have formed the southern extremity of the peninsula of India. This opinion is confirmed both by its position and its geological constitution. At the present period the narrow channel which separates them is only a few feet in depth, and I believe I shall be able to prove that the whole of Ceylon is gradually rising above the sea level, and that consequently the time, geologically speaking, is not far distant when the island will again become united to the continent. Tradition, indeed, records that the passage was at one time not only broader but much deeper than it now is, and this led to the survey which preceded the deepening of the Pamban passage.

The island is about 270 miles long, by about 145 in breadth. It is of an ovate form, and its extremities point nearly due south and north. It is broadest at its southern extremity, and it is in that direction that the greatest mass of high land exists. The great central mountain range rises, for the most part, rather suddenly out of a broad belt of flat country that stretches between it and the sea, and which varies from twenty to sixty or eighty miles in breadth, but towards the north, north-west, and north-east, the flats are much broader than in any other direction. The general direction of the mountain chain is from south to north, but it is much broken up, and intersected by beautiful broad and fertile valleys, varying from one to six thousand feet above the level of the sea. The mountains themselves vary from 3,000 to 8,280 feet, the latter being the elevation of Pedrutalagala, a rounded dome which overlooks the valley of Nuwara-Eliya on the one side and that of Maturata on the other. The peaks which come next to this one in point of elevation are Kirigalpotta, to the south of it, which is 7,810 feet; Totapella, to the eastward, which is 7,720 feet; and Adam's Peak, which for a long period was considered, as it still is by the natives, to be the highest, of all, 7,420 feet. Taking their rise in these mountains, and traversing the valleys, are, of course, a number of streams of various sizes. The largest of these is the Mahaweliganga—the Ganges of Ptolemy—which has its origin near the summit of Pedrutalagala, and, after a very tortuous course of nearly 200 miles, ultimately falls into the sea near Trincomalee, on the north-east side of the island. Three or four other streams of considerable size empty themselves on the west coast.

Although the geological structure of the Island is very simple, it offers notwithstanding much that is interesting to the geologist. The series of rocks are but few in number. The lowest, which is also the most common, is that to which the name of gneiss is given. In some places it is overlaid by extensive beds of Dolomitic lime-stone; and on some parts of the coast that very modern formation known by the name of Breccia is found to exist. The clay slate, silurian, old red sand stone, carboniferous, new red sand-stone, oolite, and chalk systems, which form such remarkable features in the Geology of England, have not yet been met with in Ceylon, nor is it at all probable that any of them ever will be found, as the island has now been traversed in all directions without any traces of them having been seen.

Gneiss rocks are the lowest of that division to which the name of stratified is given, in contra-distinction to those which show no traces of strati-

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fication, such as granite, basalt, and lavas. Wherever the undersurface of the Gneiss series is sufficiently exposed, it is always found to rest on granite; but owing to the great thickness of the system in Ceylon, and notwithstanding that it has been much broken by the upheaval of the mountains, I have not yet been able to trace their connection. It has however, recently been discovered at Mount Lavinia, near Colombo, by the Rev. Dr. Macvicar. The mechanical structure of Gneiss shews that it has been formed at the expense of granite by disintegration, much in the way that the sand-stone of the carboniferous system has had its origin, and that which is now being formed on the sea-shores of our own times: and that it has afterwards been partly fused by heat from below. Mr. Lyell, indeed, asserts, and all that we yet known of Geology goes to prove the truth of the assertion, that granite itself has been formed by the complete fusion and reconsolidation of pre-existing stratified rocks, and that as new stratified rocks are slowly deposited by water above the earth, the older ones which they cover are gradually reabsorbed by the interior heat of the globe, and converted into granite. According to this view we have, as in the organic world, an endless round of production and decay going on from pre-existing materials; and it is from this circumstance that Mr. Lyell has given the name of metamorphic rocks to those lower stratified ones, to which the name of transition was formerly applied.

The materials of which gneiss and granite are formed are the same, consisting of the minerals called felspar, mica, quartz, and hornblende, in greater or less proportions; but if a portion of each be carefully examined, these materials will be found to be in a very different state of molecular aggregation. In granite these minerals are always found to be perfectly crystallized within, and to have externally a regular geometric figure while in gneiss, though the internal crystallization remains, the felspar is rounded like water-worn pebbles, or broken into fragments, and the plates of mica are contorted by irregular pressure among the felspar and quartz, shewing that they were brought together by the mechanical influence of water, and not by chemical attraction while in a state of fusion, as in granite. These distinctions, however, are only of practical value when small portions of either rock are under investigation, for while granite in the mass presents no evidence of stratification, in gneiss, on the contrary, it is always observable, particularly where sections of the rock in *situ* have been made; and as such sections are now everywhere to be met with along the new roads which intersect the interior of the island, the various bendings, elevations and depressions which these rocks have been subjected to since they were quietly and horizontally deposited in the bed of a primæval ocean, can be very satisfactorily studied.

Portions of these rocks are sometimes of a very arenaceous character, so much so, indeed, as often to cause them to be taken for actual sandstone by common observers. Such portions can always, however, be traced running into the regular and more compact gneiss Extensive veins of both pure quartz and felspar are often met with in the gneiss, and probably have been produced by the same cause which mineral veins owe their origin to, viz., a fissure which has been filled up from the surrounding rock by chemical and electrical action, long but steadily continued. Those chalk-like deposits which are met with at Nuwara Eliya and elsewhere, are formed by the disintegration of felspar veins, and constitute that substance to which the name of porcelain clay is given.

In several parts of the island the gneiss is intersected by veins of trap rocks, which have been thrown up from below in a molten state subsequent to the consolidation of the gneiss. Such veins or dykes may be seen on the beach between the Admiral's house and the dockyard at Trincomalee, on the ascent of Adam's Peak from Ratnapura, and close to the sea on that side of Mrs. Gibson's hill which looks towards Galle. The latter consists of pitchstone porphyry, highly impregnated with iron, and the effect which it has produced in altering the nature of the gneiss, where it has come in contact with it, is very striking.

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With regard to the existence of metallic veins in the mountains of Ceylon almost nothing is known. Traces of tin have lately been said to have been met with; and it is not at all unlikely that it may hereafter be met with in greater abundance, as it is principally in the metamorphic rocks that metallic veins are found to exist, and mostly in mountainous countries or their immediate neighbourhood. As their existence however cannot be predicted, further knowledge concerning them will only be obtained by actual examination of those parts of the island most likely to possess them.

It is often asked if there is any chance of coal being found in Ceylon. Although from all that is yet known of the geology of the island, the chances are very much against any thing like a true coal formation being met with, yet it would not be safe to give a decided answer on the subject; for, unlike the carboniferous beds of England, which have in general one or more systems of stratified rocks intervening between them and the gneiss, those of the north of India were found by Dr. Royle to rest on the Gneiss itself. This much, however, is certain, that whenever Gneiss forms the uppermost rock, coal need never be looked for, as it is well known that in all parts of the world, the series of rocks which form the crust of it, hold a regular and undeviating-relative position to each other, and hence, the upper rock of any country being given, a Geologist can tell with the greatest certainty what system or systems of rocks will never be found beneath it.

The nature and origin of laterite or kabuk, which is so common on the west side of the Island, have given rise to much diversity of opinion. Some have supposed it to be a volcanic production, and others a deposition from water; but I have most completely satisfied myself that it owes its existence to neither of these causes, but to the simple decay of Gneiss rocks. I was first led to this view from the examination of a cut through a knoll on the road from Galle to Belligam, and afterwards from others on the road between Colombo and Ambepusse, and in numerous instances of the same nature in the Central Province. In many of these cuts there is no difficulty in tracing a continuous connection, without any definite lines of demarcation, between the soil and the laterite on the one hand, and the laterite and the solid rock on the other. In no part of the world, save in the Peninsula of India, have I witnessed a like decomposition of Gneiss, and this renders it probable that the cause is due to some peculiarity in the chemical nature of the rock itself

As in almost every other country where the Gneiss system prevails, immense deposits of crystalline lime-stone are found in various parts of the interior of the island, overlying the Gneiss. Thus, it is well known to occupy a large space in the valleys of Kundasala, Matale and Peradeniya at the latter place, and between it and Kandy, being extensively converted into lime for building purposes. This like all other lime-stone strata has evidently been formed by aqueous chemical deposition from an ocean which overlay the Gneiss, and its highly crystalline structure is probably owing to the same heat which partly fused the Gneiss itself previous to its solidification. It is not simply a carbonate of lime, but contains besides a considerable quantity of carbonate of magnesia, and to such combinations the name of dolomite is given. It is still undecided by Geologists whether the magnesia of such rocks was originally contained in the solution from which they have resulted, or from the action of heat on the rocks with which they are connected, and which as is the case with Gneiss, are known to cantain a certain proportion of Magnesia.

Passing over all those series of rocks to which the names of secondary and tertiary have been given, none of which are known to exist in Ceylon, we come to those very modern ones called post-tertiary, which are being formed at the present day, and which either shew themselves in the shape of elevated terraces of shells, or in a more solid form arising from the agglutination of particles of sand and fragments of such corallines and shells as still inhabit the surrounding seas. Such elevated shell banks, and such rocks are to be

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met with in several places along the coast. Thus the greater part of the Peninsula of Jaffna is formed of them, and I have likewise noticed their existence at Galle and at Belligam. The study of these modern formations are of peculiar interest to the geologist, as they are fraught with important analogies as to the process of nature in more ancient times. At Jaffna the lower portions of this breccial rock is quarried for building purposes. It is compact in its structure, but abounds in very perfect remains of shells and corals, and in its general structure resembles very much the same kind of rock in which human remains have been found on the northeast coast of the main land of Guadaloupe. Along the shores of the lagoon which separates the main land from the peninsula of Jaffna, and but little elevated above the present sea level, the formation of this rock may be seen in various states of progress towards solidification. Some specimens which I collected there consist of nearly an entire mass of small shells similar to those which are still found abundantly alive within the present tidal range, and are beautiful examples of the manner in which those limestone rocks of the secondary strata which so full of the remains of shells and other marine animals, have been formed. At Galle a somewhat similar kind of rock is used for building purposes, but the shells and corallines of which it is composed are more comminuted. At one of the places where this rock is worked, situated about a mile from the sea, and about six or eight feet above its present level, I found firmly attached to those portions of it which were exposed by the removal of the alluvial soil which covered them, numerous oyster shells, exactly similar to those now found alive on rocks at present washed by the waves of the ocean. At Belligam a large tract of alluvial land, which at the time I visited that place, in 1844, was planted with sugar cane, is underlaid by a thick stratum of sea shells and fragments of corallines, which are more or less firmly agglutinated together; and I have no doubt that many other parts of the coast offer similar phenomena.

The existence of these masses of shells above the present level of the sea, yields the same evidence of the gradual rise of the island of Ceylon, that is afforded by similar appearances in other parts of the world, and from which similar conclusions have been drawn by the most eminent geologists of the day. In many places where such rises are slowly but surely going on, the rate is so imperceptible that but little change has been observed during the historical period; where as in others, such as the Scandinavian peninsula, the rise is as much as three feet in the course of a century. From all that I have seen I am led to believe that the whole of that flat sandy country which stretches along the west coast of Ceylon, as well as that of a similar nature at Batticaloa, which, except Trincomalee which is rocky, is the only part of the east coast that I have yet visited, has, at no very recent geological epoch been gained from the sea by the elevation of the land.

The conclusions to be deduced from the above slight sketch of the Geology of the Island are very evident. In the first place, the non-existence of secondary and tertiary rocks overlying the Gneiss and Dolomite, prove that from the period of the first elevation of Ceylon above the level of the ocean, it has not been subjected to the numerous submersions and upheavals which, it is well ascertained, such countries as possess them have been liable to; indeed, there is no evidence to prove that it has even once been covered with water since the time at which it first became dry land, for nearly the whole of the soil which covers it, with the exception of the sandy portions along the coast, and a very thin layer of alluvial matter has been formed from the decay of the gneiss rocks. Nowhere have I met with traces of diluvial drift, except, indeed, where it can be traced to the action of streams. In the second place, the gradual rise of the whole island may be fairly inferred from the existence of the elevated beaches which I have alluded to, and I have no doubt that when further attention has been given to the subject by those who have opportunities for so doing, still more satisfactory evidence of the fact will be afforded.

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METALS, MINERALS AND GEMS.

(From *Sir Emerson Tennent's* "*Ceylon.*")

METALS.—The plutonic rocks of Ceylon are but slightly metalliferous, and hitherto their veins and deposits have been but imperfectly examined. The first successful survey attempted by the Government was undertaken during the administration of Viscount Torrington, who, in 1847, commissioned Dr. Gygax to proceed to the hill district south of Adam's Peak, and furnish a report on its products. His investigations extended from Ratnapura in a south-eastward direction, to the mountains which overhang Bintenne, but the results obtained did not greatly enlarge the knowledge previously possessed. He established the existence of *tin* in the alluvium along the base of the mountains to the eastward towards Idelgashena; but so circumstanced, owing to the flow of the Wellaway river, that, without lowering its level, the metal could not be extracted with advantage. The position in which it occurs is similar to that in which tin ore presents itself in Saxony; and along with it, the natives, when searching for gems, discover garnets, corundum, white topazes, zircon, and tourmaline.

Gold is found in minute particles at Getteyhedra, and in the beds of the Maha Oya and other rivers flowing towards the west. (*a*) But the quantity hitherto discovered has been too trivial to reward the search. The early inhabitants of the island were not ignorant of its presence; but its occurrence on a memorable occasion, as well as that of silver and copper, is recorded in the Mahawanso as a miraculous manifestation, which signalised the founding of one of the most renowned shrines at the ancient Capital. (*b*)

Nickel and *cobalt* appear in small quantities in Saffaragam, and the latter, together with *rutile* (an oxide of titanium) and *wolfram*, might find a market in China for the colouring of porcelain. (*c*) *Tellurium*, another rare and valuable metal, hitherto found only in Transylvania and the Ural has likewise been discovered in these mountains. *Manganese* is abundant, and *Iron* occurs in the form of magnetic iron ore, titanite, chromate, yellow hydrated, peroxide and iron pyrites. In most of these, however, the metal is scanty, and the ores of little comparative value, except for the extraction of manganese and chrome. "But there is another description of iron ore," says Dr. Gygax, in his official report to the Ceylon Government, "which is found in vast abundance, brown and compact, generally in the state of carbonate, though still blended with a little chrome, and often molybdena. It occurs in large masses and veins, one of which extends for a distance of fifteen miles; from it millions of tons might be smelted, and when found adjacent to fuel and water-carriage, it might be worked to a profit. The quality of the iron ore found in Ceylon is singularly fine; it is easily smelted, and so pure when reduced as to resemble silver. The

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a Ruanwella, a fort about forty miles distant from Colombo, derives its name from the sand of the river which flows below it,—rang-welle, "golden sand." Rang-gala in the central province, is referable to the same root—the rock of gold.

b *Mahawanso.* ch. xxiii. p. 166, 167.

c *Asiatic Annual Register* for 1799 contains the following:—

"*Extract from a letter from Colombo dated* 26*th* Oct 1798.

"A discovery has been lately made here of a very rich mine of *quicksilver*, about six miles from this place. The appearances are very promising, for a handful of the earth on the surface will, by being washed, produce the value of a rupee. A guard is set over it, and accounts sent express to the Madras Goverment."—P. 53. See also PERCIVAL's *Ceylon*, p. 539.

JOINVILLE, in a MS. essay on *The Geology of Ceylon*, now in the library on the East India Company, says that near Trincomalee there is "un sable noir, compose de detriments de trappe et de cristaux de fer, *dans lequel on owve per le lavage beaucoup de mercure.*"

rough ore produces from *thirty* to *seventy-five* per cent., and on an average fully *fifty*. The iron wrought from it requires no puddling, and, converted into steel, it cuts like a diamond. The metal could be laid down in Colombo at £6 per ton, even supposing the ore to be brought thither for smelting, and prepared with English coal; but *anthracite* being found upon the spot, it could be used in the proportion of three to one of the British coal; and the cost correspondingly reduced."

Remains of ancient furnaces are met with in all directions precisely similar to those still in use amongst the natives. The Singhalese obtain the ore they require without the trouble of mining; seeking a spot where the soil has been loosened by the latest rains, they break off a sufficient quantity, which, in less than three hours, they convert into iron by the simplest possible means. None of their furnaces are capable of smelting more than twenty pounds of ore, and yet this quantity yields from seven to ten pounds of good metal.

The *anthracite* alluded to by Dr. Gygax is found in the southern range of hills near Nambepane, in close proximity to rich veins of *plumbago*, which are largely worked in the same district, and the quantity of the latter annually exported from Ceylon exceeds a thousand tons. (*a*) *Molybdena* is found in profusion dispersed through many rocks in Saffragam, and it occurs in the alluvium in grey scales, so nearly resembling plumbago as to be commonly mistaken for it. *Kaolin*, called by the natives *Kirimattie*, appears at Nuwara Eliya, at Hewahette, Kadugannawa, and in many of the higher ranges as well as in the low country near Colombo; its colour is so clear as to suit for the manufacture of porcelain (*b*); but the difficulty and cost of carriage render it as yet unavailing for commerce and the only use to which it has hitherto been applied is to serve for whitewash instead of lime.

Nitre has long been known to exist in Ceylon, where the localities in which it occurs are similar to those in Brazil. In Saffragam alone there are upwards of sixty caverns known to the natives, from which it may be extracted, and others exist in various parts of the island, where the abundance of wood to assist in its lixiviation would render that process easy and profitable. Yet so sparingly has this been hitherto attempted; that even for purposes of refrigeration, crude saltpetre is still imported from India. (*c*)

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a That was twenty-five years ago: now as much as 8,000 tons of plumbago are sometimes exported in one year.—COMPILERS.

b The Kaolin of Ceylon, according to an analysis in 1847, consists of:—

Pure kaolin	70·0
Silica	26·0
Molybdena and iron oxide	4·0
	100·0

In the *Ming-she*, or history of the Ming dynasty, A. D. 1368—1643, by Chanting-yuh, "pottery-stone" is enumerated among the imports into China from Ceylon.—B. cccxxvi. p. 5. [A cup and saucer made from Ceylon kaolin by "Minton" to the order of Governor Sir William Gregory, will be found in the Colombo Museum.—COMPILERS.]

c The mineralogy of Ceylon has hitherto undergone no scientific scrutiny, nor have its mineral productions been arranged in any systematic and comprehensive catalogue. Specimens are to be found in abundance in the hands of native dealers; but from indifference or caution they express their inability to afford adequate information as to their locality, their geological position, or even to show with sufficient certainty that they belong to the island. Dr. Gygax, as the results of some years spent in exploring different districts previous to 1847, was enabled to furnish a list of but thirty-seven species, the site of which he had determined by personal inspection. These were:—1, Rock crystal, Abundant; 2, Iron quartz, Saffragam; 3, Common quartz, Abundant; 4, Amethyst, Galle Back, Caltura; 5, Garnet, Abundant; 6, Cinnamon stone, Belligam; 7, Harmotome, St. Lucia, Colombo 8, Hornblende, Abundant; 9, Hypersthene, Abundant; 10, Common corundum, Badulla; 11, Ruby, Badulla and Saffragam; 12, Chrysoberyl, Ratganga,

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GEMS.—But the chief interest which attaches to the mountains and rocks of the region, arises from the fact that they contain those mines of *precious stones* which from time immemorial have conferred renown on Ceylon. The ancients celebrated the gems as well as the pearls of "Taprobane;" the tales of mariners returning from their eastern expeditions supplied to the storytellers of the Arabian Nights their fables of the jewels of "Serendib;" and the travellers of the Middle Ages, on returning to Europe, told of the "sapphires, topazes, amethysts, garnets, and other costly stones" of Ceylon, and of the ruby which belonged to the King of the island, "a span in length, without a flaw, and brilliant beyond description." (*d*)

The extent to which gems are still found is sufficient to account for the early traditions of their splendour and profusion; and fabulous as this story of the ruby of the Kandyan Kings may be, the abundance of gems in Saffragam has given to the Capital of the district the name of *Ratnapura*, which means literally "the city of rubies." (*e*) They are not, however, confined to this quarter alone, but quantities are still found on the western plains between Adam's Peak and the sea, at Nuwara Eliya, in Uva, at Kandy, at Matale in the Central Province, and at Ruwanwella near Colombo, at Matura, and in the beds of the rivers eastwards towards the ancient Mahagam.

But the localities which chiefly supply the Ceylon gems are the alluvial plains at the foot of the stupendous hills of Saffragam, in which the detritus of the rocks has been carried down and intercepted by the slight elevations that rise at some distance from the base of the mountains. The most remarkable of these gem-bearing deposits in the flat country around Balangoda, south-east of Ratnapura; but almost every valley in communication with the rocks of the higher ranges contains stones of more or less value, and the beds of the rivers flowing southward from the mountain chain are so rich in comminuted fragments of rubies, sapphires, and garnets, (*f*) that their sands in some places are used by lapidaries in polishing the softer stones, and in sawing the elephants' grinders into plates. The cook of a Government Officer

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North Saffragam; 13, Pleonaste, Badulla; 14, Zircon, Walawey-ganga, Saffragam; 15, Mica, Abundant; 16, Adular, Patna Hills, North-east; 17, Common felspar, Abundant; 18, Green felspar, Kandy; 19, Albite, Melly Matté; 20, Chlorite, Kandy; 21, Pinite, Patna Hills: 22, Black tourmaline, Nuwara Eliya; 23, Calcspar, Abundant; 24, Bitterspar, Abundant; 25, Apatite, Galle Back; 26, Fluorspar, Galle Back; 27, Chiastolite, Mount Lavinia; 28, Iron pyrites, Peradenia; 29, Magnetic iron pyrites, Peradenia, Rajawelle; 30, Brown iron ore, Abundant; 31, Spathose iron ore, Galle Back; 32, Manganese, Saffragam: 33, Molybden glance, Abundant; 34, Tin ore, Saffragam; 35, Arseniate of nickel, Saffragam; 36, Plumbago, Morowa Korale; 37, Epistilbite, St. Lucia.

d *Travels of* MARCO POLO, *a Venetian, in the Thirteenth Century*, London, 1818.

e In the vicinity of Ratnapura there are to be obtained masses of quartz of the most delicate rose colour. Some pieces, which were brought to me in Colombo, were of extraordinary beauty; and I have reason to believe that it can be obtained in pieces large enough to be used as slabs for tables, or formed nto vases and columns. I may observe that similar pieces are to be found in the south of Ireland, near Cork.

f MR. BAKER, in a work entitled *The Rifle and the Hound in Ceylon*, thus describes the sands of the Manic Ganga, near the ruins of Mahagam, in the south-eastern extremity of the island:—"The sand was composed of mica, quartz, sapphire, ruby, and jacinth; but the large proportion of ruby sand was so extraordinary that it seemed to rival Sinbad's story of the vale of gems. The whole of this was valueless, but the appearance of the sand was very inviting, as the shallow stream in rippling over it magnified the tiny gems into stones of some magnitude. I passed an hour in vainly searching for a ruby worth collecting, but the largest did not exceed the size of a mustard seed."—BAKER'S *Rifle and Hound in Ceylon*, p. 181.

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at Galle recently brought to him a ruby about the size of a small pea, which he had taken from the crop of a fowl.

Of late years considerable energy has been shown by those engaged in the search for gems; neglected districts have been explored, and new fields have been opened up at such places as Karangoda and Weralupa, whence stones have taken of unusual size and value.

It is not, however, in the recent strata of gravel, nor in those now in process of formation, that the natives search for gems. They penetrate these to the depth of from ten to twenty feet, in order to reach a lower deposit distinguished by the name of *Nellan* in which the objects of their search are found. This is of so early a formation that it underlies the beds of rivers, and is generally separated from them or from the superincumbent gravel by a hard crust (called *Kadua*), a few inches in thickness, and so consolidated as to have somewhat the appearance of latarite, or of sun-burnt brick. The nellan is for the most part horizontal, but occasionally it is raised into an incline as it approaches the base of the hills. It appears to have been deposited previous to the eruption of the basalt, on which in some places it reclines, and to have undergone some alteration from the contact. It consists of water-worn pebbles firmly imbedded in clay, and occasionally there occur large lumps of granite and gneiss, in the hollows under which, as well as in "pockets" in the clay (which from their shape the natives denominate "elephants' footsteps") gems are frequently found in groups as if washed in by the current.

The persons who devote themselves to this uncertain pursuit are chiefly Singhales, and the season selected by them for "gemming" is between December and March, when the waters are low. (*a*) The poorer and least enterprising adventurers betake themselves to the beds of streams, but the most certain though the most costly course is to sink pits in the adjacent plains, which are consequently indented with such traces of recent explorers. The upper gravel is pierced, the covering crust is reached and broken through and the nellan being shovelled into conical baskets and washed to free it from the sand, the residue is carefully searched for whatever rounded crystals and minute gems it may contain.

It is strongly characteristic of the want of energy in the Singhalese, that although for centuries those alluvial plains and watercourses have been searched without ceasing, no attempt appears to have been made to explore the rocks themselves, in the debris of which the gems have been brought down by the rivers. Dr. Gygax says:—"I found at Hima Pohura, on the south-eastern decline of the Pettigala-Kanda, about the middle of the descent, a stratum of grey granite containing, with iron pyrites and molybdena, innumerable rubies from one tenth to a fourth of an inch in diameter, and of a fine rose colour, but split and falling to powder. It is not an isolated bed of minerals, but a regular stratum extending probably to the same depth and distance as the other granite formations. I followed it as far as was practicable for close examination, but everywhere in the lower part of the valley I found it so decomposed that the hammer sunk in the rock, and even bamboos were growing on it. On the higher ground near some small round hills which intercept it, I found the rubies changed into brown corundum. Upon the hills themselves the trace was lost, and instead of a stratum there was merely a wild chaos of blocks of yellow granite. I carefully examined all the minerals which this stratum contains:—felspar, mica, and quartz molybdena, and iron pyrites,—and I found all similar to those I had previously got adhering to rough rubies offered for sale at Colombo. *I firmly believe that in such strata the rubies of [illegible] are originally found*, and that those in the white and blue

a A very interesting account of *Gems and Gem Searching*, by MR. WM. STEWART, appeared in the *Colombo Observer* for June, 1855. [See page 111 *et seq.* —COMPILERS.

clay at Balangoda and Ratnapura are but secondary deposits. I am further inclined to believe that these extend over the whole island, although often intercepted and changed in their direction by the rising of the yellow granite." It is highly probable that the finest rubies are to be found in them, perfect and unchanged by decomposition; and that they are to be obtained by opening a regular mine in the rock like the ruby mine of Badakshan in Bactria described by Sir Alexander Burnes. Dr. Gygax adds that having often received the minerals of this stratum with the crystals perfect, he has reason to believe that places are known to the natives where such mines might be opened with confidence of success.

Rubies both crystalline and amorphous are also found in a particular stratum of dolomite at Bulattota and Badulla, in which there is a peculiar copper-coloured mica with metallic lustre. *Star rubies*, the "asteria" of Pliny (so called from their containing a movable six-rayed star), are to be had at Ratnapura and for very trifling sums. The blue tinge which detracts from the value of the pure ruby, whose colour should resemble "pigeon's blood," is removed by the Singhalese, by enveloping the stone in the lime of a calcined shell and exposing it to a high heat. *Spinel* of extremely beautiful colours is found in the bed of the Mahaweli-ganga at Kandy, and from the locality it has obtained the name of *Candite*.

It is strange that although the *sapphire* is found in all this region in greater quantity than the ruby, it has never yet been discovered in the original matrix, and the small fragments which sometimes occur in dolomite show that there it is but a deposit. From its exquisite colour and the size in which it is commonly found, it forms by far the most valuable gem of the Island. A piece which was dug out of the alluvium within a few miles of Ratnapura in 1853, was purchased by a Moor at Colombo, in whose hands it was valued at upwards of four thousand pounds.

The original site of the *oriental topaz* is equally unknown with that of the sapphire. The Singhalese rightly believe them to be the same stone only differing in colour, and crystals are said to be obtained with one portion yellow and the other blue.

Garnets of inferior quality are common in the gneiss, but finer ones are found in the hornblende rocks.

Cinnamon-stone (which is properly a variety of garnet) is so extremely abundant, that vast rocks containing it in profusion exist in many places, especially in the alluvium around Matura; and at Belligam, a few miles east from Point-de-Galle, a vast detached rock is so largely composed of cinnamon-stones that it is carried off in lumps for the purpose of extracting and polishing them.

The *Cat's-eye* is one of the jewels of which the Singhalese are especially proud, from a belief that it is only found in their island; but in this I apprehend they are misinformed, as specimens of equal merit have been brought from Quilon and Cochin on the southern coast of Hindustan. The cat's-eye is a greenish translucent quartz, and when cut *en cabochon* it presents a moving internal reflection which is ascribed to the presence of filaments of asbestos. Its perfection is estimated by the natives in porportion to the narrowness and sharpness of the ray and the pure olive-tint of the ground over which it plays.

Amethysts are found in the gneiss, and some discoloured though beautiful specimens in syenite; they are too common to be highly esteemed. The "Matura Diamonds," which are largely used by the native jewellers, consist of zircon, found in the syenite not only uncoloured but also of pink and yellow tints, the former passing for rubies.

But one of the prettiest though commonest gems in the island is the "Moon-stone," a variety of pearly adularia presenting chatoyant rays when simply polished. They are so abundant that the finest specimens may be bought for a few shillings. These with *aqua marina*, a bad description of

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opal rock crystal in extremely large pieces, *tourmaline*, and a number of others of no great value, compose the list of native gems procurable in Ceylon. (*a*) Diamonds, emeralds, agates, cornelians opal and turquoise, when they are exhibited by the natives, have all been imported from India.

During the dynasty of the Kandyan sovereigns the right of digging for gems was a royalty reserved jealously for the King; and the inhabitants of particular villages were employed in their search under the superintendence of hereditary officers, with the rank of "Mudianse." By the British Government the monopoly was early abolished as a source of revenue, and no license is now required by the jewel-hunters.

Great numbers of persons of the worst-regulated habits are constantly engaged in this exciting and precarious trade; and serious demoralisation is engendered amongst the villagers by the idle and dissolute adventurors who resort to Saffragam. Systmatic industry suffers, and the cultivation of the land is frequently neglected whilst its owners are absorbed in these speculative and tantalising occupations.

The products of their searches are disposed of to the Moors, who resor to Saffragam from the low country, carrying up cloth and salt, to be exchanged for gems and coffee. At the annual Buddhist festival or the Perahara, a jewel-fair is held at Ratnapura, to which the purchasers resort from all parts of Ceylon. Of late years, however, the condition of the people in Saffragam has so much improved that it has become difficult to obtain the finest jewels, the wealthier natives preferring to retain them as investments: they part with them reluctantly, and only for gold, which they find equally convenient for concealment. (*b*)

The lapidaries who cut and polish the stones are chiefly Moors, but their tools are so primitive and their skill so deficient, that a gem generally loses in value by having passed through their hands. The inferior kinds, such as cinnamon-stones, garnets, and tourmaline, are polished by ordinary artists at Kandy, Matura, and Galle; but the more expert lapidaries, who cut rubies and sapphires, reside chiefly at Caltura and Colombo.

As a general rule, the rarer gems are less costly in Europe than in Colombo. In London and Paris the quantities brought from all parts of the world are sufficient to establish something like a market value; but, in Ceylon, the supply is so uncertain that the price is always regulated at the moment by the rank and wealth of the purchaser. Strange to say, too, there is often an unwillingness even amongst the Moorish dealers to sell the rarest and finest specimens; those who are wealthy being anxious to retain them, and few but stones of secondary value are offered for sale. Besides, the Rajahs and native Princes of India, amongst whom the passion for jewels is universal, are known to give such extravagant prices that the best are always sent to them from Ceylon.

From the Custom House returns it is impossible to form any calculation as to the value of the precious stones exported from the island. A portion only appears, even of those sent to England, the remainder being carried away by private parties. Of the total number found, one-fourth is probably purchased by the natives themselves, more than one-half is sent to the Continent of India, and the remainder represents the export to Europe. Computed in this way, the quantity of precious stones found in the island may be estimated at 10,000*l.* per annum. [This all refers to a generation back: now the amount is much greater, as much as £7,000 worth of gems having been picked up on one property in the Rakwana District in a twelvemonth.—COMPILERS.]

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a Caswini and some of the Arabian geographers assert that the diamond is found at Adam's Peak; but this is improbable, as there is no formation there resembling the *casealhao* of Brazil or the diamond conglomerate of Golconda. If diamonds were offered for sale in Ceylon, in the time of the Arab navigators, they must have been brought thither from India. (*Journ. As. Soc. Beng.* xiii. 633.;

b So eager is the appetite for hoarding in these hills, that eleven rupees equal to twenty-two shillings) have frequently been given for a sovereign.

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PRECIOUS STONES.

(From *Philalethes'* "*Ceylon.*")

The mountains of Ceylon probably contain a variety of mineral treasures, which it is reserved for the future researches of philosophy, or of avarice, to disclose. Among the precious stones of the island, the emerald, with the cat's-eye, are held in the highest estimation. "Cat's-eye is the name given to a very hard stone, which approaches more or less to a white or green, and is semi-diaphanous, with a streak of the breadth of a line in the middle, which streak is much whiter than the stone itself, and throws its light to whatever side soever this is turned. In this respect therefore it resembles a cat's-eye, whence it derives its name." Thunberg, to whom I am indebted for this description, says, that the largest specimen which he saw of this species of stone was of the size of a hazel nut. Mr. Cordiner tells us that a perfect cat's-eye of this size is worth 1,500 rix-dollars of Ceylon currency, or £150 sterling. Rubies, for which Ceylon was renowned at a very early period, are seldom found at present of any considerable size; and are not often larger than particles of gravel or grains of barley. The Indians speak of them as more or less ripe, which means more or less high-coloured. In proportion as the ruby is of a deeper red it is more transparent, and consequently of greater value. The Moors, according to Thunberg, say, that they approach in hardness nearest to the diamond.

The Moors are here the chief dealers in precious stones, both in their rough and in their polished state; but they are said to be very dexterous in imposing counterfeit for genuine gems. The precious stones of Ceylon are found more especially in the region of Matura. Sometimes they are discovered on the surface of the earth, and in other places at the depth of from one, two, or three, to twenty or more feet.

(From *Knox's* "*Ceylon.*")

In this island are several sorts of precious stones, which the king, for his part, has enough, and so careth not to have more discovery made. For in certain places, where they are known to be, are sharp poles set up fixed in the ground, signifying, that none, upon, pain of being stuck and impaled upon those poles, presume so much as to go that way. Also there are certain rivers, out of which, it is generally reported, they do take rubies and sapphires for the king's use, and cat's-eye; and I have seen several pretty coloured stones, some as big as cherry-stones, some as buttons, and transparent, but understood not what they were. Rubies and sapphires I myself have seen here.

Here is iron and crystal in great plenty. Saltpetre they can make. Brimstone, some say, is here, but the king will not have it discovered. Steel they can make of their iron. Ebony in great abundance, with choice of tall and large timber. Cardamoms, jaggery, rack, oil, black lead, turmeric, salt, rice, betel-nuts, musk, wax, pepper; which last grows here very well, and might be in great plenty if it had a vend: and the peculiar commodity of the island, cinnamon. Wild cattle and wild honey in great plenty in the woods; it lies in holes or hollow trees, free for any that will take the pains to get it. Elephant's teeth and cotton; of which there is good plenty growing in their own grounds, sufficient to make them good and strong cloth for their own use, and also to sell to the people of the Uplands, where cotton is not so plenty. All these things the land affords, and it might do it in much greater quantity if the people were but laborious and industrious; but that they are not, for the Chingulays are naturally a people given to sloth and laziness, if they can but anyways live. if they can but anyways live, they abhor to work; only what their necessities force them to do, they do, that is, to get food and raiment. Yet in this I must a little vindicate them; for what indeed should they do with more than food and raiment, seeing, as their estates increase, so do their taxer also? And although the

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people be generally covetous, spending but little, scraping together what they can, yet such is the Government they are under, that they are afraid to be known to have anything, lest it be taken away from them. Neither have they any encouragement for their industry, having no vend by traffic and commerce for what they have got.

GEMS AND GEM-SEARCHING IN SAFFRAGAM.

(From the *Colombo Observer*, June 11, 1855.)

Ratnapura, 8th June, 1855.

To the Editors of the Colombo Observer.

SIRS,—If you deem the accompanying account of the Gems and the Gem-men of Saffragam of sufficient interest to appear in your valuble paper, I shall feel obliged by your inserting it at the earliest convenience.

I remain, your most obedient servant,

J. F. STEWART.

AN ACCOUNT OF THE GEMS AND GEM-MEN OF THE DISTRICT OF SAFFRAGAM.

The district of Saffragam has from the earliest times been famed for the various sorts of precious stones and gems found in it, and no doubt its principal town Ratnapura (*Anglice*, Gem City), owes its name to the circumstance. Tradition has it, that a peculiar people called "*Mookaro*," (probably a race of Malabars, some of whom, I believe, even now are called Mookara), were the first engaged in mining for gems, and that their leader whom the people now call "Mookery," a woman, had left the island, with a ship-load of precious stones, which said ship had foundered at sea through the evil influence of some demon or other. In support of this, the people now show mounds of earth and pits of different depths in gem-productive localities as the remains of their operations, and also adduce the fact of pieces of earthenware, beads, charcoal, &c., being found at great depths, where they could not possibly have found their way, unless such places were at some great distance of time excavated. And they further suppose that the original contrivance used for washing the gravel in which the gems are found was an earthen-vessel now called "Koraha," as the greater number of fragments of earthenware found in such places are those of such utensils, whereas the present means is a wicker-basket to be described hereafter.

To avoid technical names, the gems found in this district are the ruby, the sapphire, the topaz, the cat's-eye, the pink ruby, the green, yellow and white crystal [quartz], and the toramally [tourmaline].

The ruby (ratha of the Sinhalese, and also called "neelakantia" by them when there is a dash of blue in it) is the hardest and the most beautiful and valuable of the gem-tribe in Ceylon. It is scarce, and when found is of considerable size and seldom pure—that is without defects. But of late large sized ones have been discovered, though not pure. The defects of this stone are many; the principal which renders it almost valueless is what is called "*Coovangoo*," as in fact it does other stones, excepting the toramally, the value of which, when it exists in it to a certain degree, it enhances, converting it into a cat's-eye to be described hereafter. This "Coovangoo" is perhaps the result of imperfect crystalization. The other defects are cracks, and other flaws called "*mola ncero*" which are dark specks in the body of the stone. From one or the other of these imperfections the stone is seldom found free. Then, the colour may be more or less than the standard, detracting from its value; but the tinge of blue which is frequently found in the stone (giving it the name of neelakantia) is easily removed by burning. The process is simple and is as follows:—The stone is enclosed in a thick coating of chunam [lime] (that which is used by the natives with their betel-leaves) and

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then exposed to a strong heat.. The operation is repeated until the whole of the blue tinge is removed. But care should be taken to subject only such stones as are perfectly free from cracks to this, for one with cracks, if subjected to heat, is said to crumble down in pieces. Ths stone, the beautiful colour of which is so well known, is prized alike among Europeans and Asiatics.

The next stone of value is the Sapphire. ("Nila" Sinhalese). It is perhaps the most plentifully disseminated (if the word be correct) of the gem tribe in the district.—Like its congeners, it is seldom found without blemish, and of the proper colour, though, it has frequently been discovered in largish pieces. It is the next in value to the ruby, that variety called "*Indra Neela*" being reckoned the best by the Sinhalese. In this sort there is a slight shadow of ruby-red as it were mixed up with blue. One of this variety, of an extraordinary size and purity, was found some time ago within a few miles of Ratnapura, giving origin to great litigation among the people in whose land it was found. It is said to have changed hands, and to be now in the possession of a wealthy Moorman of Colombo who has refused the offer of £4,500 for the purchase of it. One has lately been found in a new *gem field* close to Ratnapura of a smaller size, but of better colour as is said, than the one above described. The sapphire, the blue colour of which is so much admired, is equally valued by Europeans and natives.

The Topaz (*puspa raga*, Sinhalese) claims notice next. There are two varieties of it: the "ratu puspa raga" and "kaha puspa raga." The former is of a bright yellow colour, with a reddish tinge and is the more valued. The latter is pure bright yellow. The first variety is scarce, and the second is comparatively plentiful. The topaz and the sapphire seem to be species of the same stone differing only in colour—it is not unfrequent to find a piece of stone partly yellow and partly blue. This stone is not much sought after by Europeans, but it is prized among the Sinhalese. It is said to sell well at the Presidencies of India and in Arabia.

The Cat's-eye ("Vyrody," Sinhalese) as has already been noticed, is a toramally with a proper degree of "coovangoo" in it, now denominated the "pasanama" producing a movable, bright, white streak in it when properly cut and polished—so that a description of the cat's-eye is in fact one of the toramally. There are three varieties of the toramally, the "kanaka,,' "palla," and the "panny" toramally. The two first varieties when they have the pasanama, produce the cat's-eye (vyrody) the first being the superior sort. The "panny toramally" has seldom the coovangoo or pasanama in it, at least such a specimen has never been seen by the writer. The "kanaka" sort is distinguished by a light green colour with a golden gloss, having the white movable streak in it. The "palla" presents a deep green ground with the streak in it. The "panny" variety, which perhaps never produces a vyrody, is of a dull syruppy colour as the name indicates, panny meaning syrup. The cat's-eye though not much regarded by the Europeans, is much prized by Asiatics, particularly by the Malays, who it is said, give high prices for such as present more than one streak of white, of which it is said rare specimens have been met with. There is a variety of cat's-eye called "barawa vyrody." It is a prefectly black stone with a movable [shifting] streak in it. Of this sort the writer has seen several specimens.

The Pink-ruby ("patmaraga" Singh.) is a beautiful stone and seldom met with. It is by some prized equally with the ruby. It is of a light ruby colour with a strong dash of a pink in it. This is likewise rarely found without blemish. It sells well when defectless, both among Europeans and Asiatics.

The last stone bearing the name precious, is the Green-crystal ("nil palingu" Sinhalese) from its sea-green colour: it is commonly known as the *Aqua Marina*. It is seldom found large or defectless, though the other varieties of which there are two are found in large lumps. These latter, the yellow and the white

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(the kaba and sudu palingu, Sinhalese) are almost valueless, the white sort being only used for spectacle glasses, though it also passes muster, when cut as brilliants, for real diamond among ornaments.

The part of the district productive in gems is the western portion of it drawing a line from Balangoda in Meda Korale to Madampe in Atacalan Korale extendiug it northwards of the limits of the district at the great mountain zone, and drawing it westwards from Madampe to the limits of Pasdum Korale. In the western portion gems are found in all directions. The chief localities for gem searching have hitherto been Getehetta near Situaka, Niriella, Karewitte, Patakadu, Watapotta, Newitegala, Boialogodda, Delwala, and a few other places; and latterly Karangoda and Weralupa, where, though gems were formerly occasionally found, at present large and surer yields are to be had of a superior quality. There is no doubt, that at present gemming is better understood, and that it is conducted on an improved system and with greater enterprise. Now the pits are excavated to greater depths in places where formerly no gravel (the matrix in which gems are found, called "*Illan*" by the Sinhalese,) was supposed to exist; whilst formerly the searchers were content to wash beds of gravel of an unsatisfactory nature situate superficially, and easier reached, but yielding an inferior description of produce. In fact it may be presumed that these superficial strata, are now exhausted, necessitating a search at greater depths, and including a sort of involuntary improvement. The pit where the great stone was found at Karangoda was at least 25 feet deep, whilst the pits now so productive at Weralupa are scarcely of less depth.

There are two ways in which gems are searched for—one in beds of streams, and the other by sinking pits on land, generally on the borders of streams, in which previously search had been made and found to contain the gravel. At Weralupa both plans are now pursued—in the stream which runs through it, and on the meadow lands on its banks, the first discoverer of the deep-seated bed of gravel having been an enterprising resident of Ratnapura. A correct description of these modes of gemming in water and on land (as the phrases run) may not be wholly without interest. In water gemmings the implements and appliances used are few and simple, consisting of a few mamoties (called "Menik Udaloo") stout, of an oblong square form, double the size of the ordinary ones, and concave on the handle surface, having a long pole called a rita, of greater or less length according to the depth of the gravel, fixed to it for a handle; a few crow-bars to break through any inpediment that may be found in the way of getting at the "illan"; a long iron sounding-rod called *Illankoora*, and a close wicker-basket called *Menikwattia*," made of the prepared split bamboo-reed (bata). This wicker-basket is an admirable contrivance for the purpose it serves: it is basin-shaped but more conical and about two feet in diameter, with a strong rim of rattan. A dry season of the year being selected, generally between December and March, when the water in the streams is low and sluggish, the gem-men commence operations by putting away the sand in the spot selected, sounding with the sounding rod from time to time to see whether the gravel is at an accessible depth. In this part of the business the ordinary coolies assist, but not after the gravel has been exposed—when only the initiated gem-men work. In the way of getting at the gravel, sometimes the impediments of the trunks of trees and blocks of rocks are found, but almost invariably a sort of crust called "catooa," has to be got through. The illan commonly lie just under this catooa or crust which presents different appearances at different places, though at times it is entirely absent. It is seldom of greater thickness than a few inches, but its hardness varies from almost that of granite to sun-baked bricks. Just under this crust, which varies in colour also in different localities, is found the illan resting on a bed of clay of greater or less thickness, and of different colours, even at short distances of space called "*Malawa*." I have seen it green, blue, grey, reddish, and at Balangoda, deep yellow; but the first mentioned colours are reckoned the most promising. It is said that under the stratum of clay, another bed of gravel has been found, richer

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than the one on the top, but of this I have no personal knowledge. The gravel being exposed, though under water, it is slowly and steadily scooped out with the mamotie above described, its concave form facilitating this, and being brought to the feet of the man engaged, is then deposited in the "Menik Wattia" (wicker basket) held under water with his feet. A sufficient quantity of illan being collected, he lays by the mamotie and washes it himself, or hands it over to another to wash, and goes on with the mamotie work. The washing of the illan is the next operation to be described, and is performed in this wise. The basket being held under water by the rim, the illan in it is rotated with a quick motion, by which the clay, now dissolved, and the lighter particles of stone are thrown out at the rim. From time to time the larger stones are taken up examined and rejected if they are not gems. The whole is now reduced down to what is called the "*Nabooa*," which is the heavy, thin sand, mostly composed of particles of precious stones, jet and the gems, the object of search, settled down by reason of their greater weight at the conical part of the basket. The basket is then brought ashore and the *nabooa* examined, when the precious stones are easily recognized and removed. The foregoing is a brief account of gemming in water. Gemming on land is done in the following manner:—The place being selected, also in the dry season, the operation of pitting is begun, the pit being invariably of the square shape. The earth being removed to the level of the water, it becomes soft. From this stage commences the sounding of the pit from time to time to ascertain whether the illan is at a practicable depth, the "illankoora" in the hands of the experienced seldom misleading. The illan being found, the gem-men are obliged to re-double their exertions as now they have to contend against the influx of water which they are obliged constantly to bale out, and this the more as they get nearer the above described "crust," over which generally lies a bed of very permeable sand of greater or less thickness. The sand being got rid of, the illan is got at either after breaking through the catooa or not, if it do not exist. The illan is detached from the bed of clay with the crow-bar and heaped up to be washed, but the larger stones that are found have almost all been discovered whilst breaking the illan from its situation. After collecting the gravel, its washings take place either in the pit itself if there be sufficient water in it or in an adjoining stream or pond, and this by the above described basket. It ought to be mentioned that the whole of the pit is not gemmed at once: the earth of only one-half is wholly removed at first, that of the other half being partly left constructed into a flight of steps to expedite the removal of earth and the baling of water. The first being exhausted of the gravel, the earth of the remaining half is thrown into the empty space, and the illan got out, thus saving a good deal of labour. I also omitted to mention that in gemming in the water, the sand of the spot on which the men with the mamoties stood, which spot is called "*Hetty Kattia*" is invariably washed, in order to detect any pieces of gem which might have fallen into the water in the act of transferring the iilan from the mamoties to the washing basket.

The gravel in which gems are found represents the following appearance. It is a layer of stones of varying thickness and compactness, mixed up with an adhesive clay over a stratum of which it generally lies. The stones of this gravel are of different sizes, and among it are found interspersed large blocks of granite and quartz. The stones composing the gravel have evidently undergone detrition in water, some being smooth and round like pebbles, and others having their angular parts worn out. Gem-producing gravel has been found in hill-sides far away from streams, yet it presents the same appearance of having undergone attrition. This is the general appearance of the gravel, but there is another sort called et-ady-illan (elephant-feet illan) the gravel being found in circular detached patches of more or less extent like the print of elephants' feet (whence its name) with hardly any trace of it in the intervals. The gem-men call this the best sort of "illan" though deceptive. One may be lucky in getting a "pocket" of gems in a part of his pit, whilst his neighbour in the adjoining

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pit gets not a handful of satisfactory gravel, and is doomed to disappointment and loss. Another circumstance noticed by the gem-men is that when a large block of stone is found in the illan, you are sure to find a valuable gem or more in the gravel under it. The bulk of the gravel is composed, independently of the gems, of pieces of quartz (tirawana-gal) and granite of different degrees of hardness. In it have also been found pieces of copper-ore as at Neriella, and nickle at Gadawelle. The crust above spoken of as generally overlying the gem-matrix, presents curious appearances. In some places it looks like vitrified sand, the effect of a high degree of heat—at others like simple induration the effect of a high degree of pressure long continued.

The right of gemming during the Kandyan Government was a Royalty, and it was exercised for a time by this Government on its accession, but in the advance of a more liberal policy, it has not been acted upon for a long series of years. In the Kandyan rule, the services of the inhabitants of several large villages called "Agra-gan" were exclusively set apart for gemming purposes. There was also a body of hereditary gem-men called "*Menik-kan-karaya*," and two *Mudiansas* (headmen)—those of Neriella and Karawita to superintend the whole establishment, whose offices were likewise hereditary. This no doubt proceeded upon a perception of the good effects of a division of labour—the cause which has given origin to the caste system throughout India now perverted from its original institution. Though there is no caste of gem-men in the country, yet it will be found that only a section of the people understand and follow the occupation of gemming, and that their labour cannot be procured at ordinary wages. To constitute the *real gem-men*, a degree of experience and manual knack are required, which can only be acquired by long practice. The system of joint-stockery on a small scale is now being introduced into gem-searching speculations—the ordinary plan now is to gem in partnership—the gem-men and the land-owners having shares in the adventure.

We have now got to the period when the gems are supposed to have come into the possession of the gem-men. They dispose of their acquisition chiefly to the Moormen, the great trading body in the interior. But they seldom do so at any other time than at the Perahera festival at the Saffragam Dewale (Temple) in August—an annual fair when an immense deal of traffic is mixed up with an equal amount of idolatrous worship and immorality. Here the gem-men and the gem-buyers congregate and effect their bargains. Though this is the usual mart where the gem produce of the preceding year exchanges hand, yet the news of any valuable gem being discovered anywhere, sets all the chicanery, influence and humbug in the district in motion to get at the possession of it at a value far less than its real worth; and in this scramble unfortunately the poor gem-men in their ignorance are frequently duped by the designing as has been the case with the finders of a great many monster stones.

In speaking of the gem-dealers at the Perahera and other times, I should notice the deceptions that are often practised on the unwary, by selling to them counterfeit gems made of coloured glass, and a sort of stone that is called "*Kerinchy*." These latter are real stones found where gems are got, but they are not *precious*. They are of a far inferior hardness and very light as compared with the weight of *real precious* stones. There are red, blue and yellow *Kerinchies*, each sort easily mistaken for rubies, sapphires, and topazes. The best test to detect their nature is to cut them with the sharp angle of a real precious stone, when they will be found to wear away in powder.

The stones being now supposed in the possession of the country trader, are sold either cut or in the rough to the wearers or to the export speculators and diffused throughout the world.

In connection with those who earn their living by gemming, I ought to notice the stone-cutters of Ceylon—they are almost all Moormen, and carry on their trade in the low-country. Some of them, however, come up to Ratnapura occasionally, and carry on their trade while business lasts, which is

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only for a short time, as very few of the gem-men get their produce cut. The simple instruments of their trade and the manner of carrying it on may be seen any day for the trouble of taking a stroll through Old Moor Street, Colombo, in the outer verandahs of which a great many will be found at work.

I have been induced to throw these cursory notes together in order to explain a subject which seems to be very little understood beyond the precincts of this district, and to draw attention to a calling which gives occupation to so large a number of its people, in the hope of advancing their interests in some degree. As I have already stated, there is great improvement observable at present in the mode of search for, and in the quality and quantity of yield of gems, but there is, it strikes me, great room for further improvements, the methods used now being still in a great measure primitive.

It is to be hoped that with the advance of experience and the late spur given to exploration since the discovery of gems at Karangoda and Weralupe at depths unreached in former times, other similar gem-fields may soon be discovered in the district, adding to its value and importance. W. S.

P.S.—The monster gem found at Weralupe, together with the other smaller pieces found in the same pit, was sold here yesterday for £273.

REPORT ON THE GEOLOGY AND MINERALOGY OF THE SABARAGAMUWA DISTRICT.

(*By Dr. Rudolph Gygax.*)

I left Colombo on my tour in July, 1847, and my instructions required me to note in a geological way, the features of the country, pointing out the peculiarities of the soil and climate; and when specimens of ores or valuable earth were found, to examine the locality with a view to ascertain the existence of any mines of value.

I started from Ratnapura, the capital of the District, and followed the course of the Walawe river for many miles, taking my way S. E. towards Balangoda; thence in the direction of the higher mountain zone overlooking the Bintenna country.

The *Geological formation* of the District appears to be similar to that known as the Cambrian and Devonian. The rocks are mostly granitic, interspersed by innumerable stratas of irruptive matter: viz., syenite, hyperstene, eupholite, and basalts in all their varieties. In the lower parts of the District the country chiefly consists of low undulating hills of quartz rock with limestone and basalt.

The *Soil* generally is of a superficial character, bearing luxuriantly a few crops, but, on being worked, very rapidly wears out. It is believed that the heavy rains at certain seasons overflowing the country from the higher forest lands descend so charged with carbonic acid from the decayed vegetation, as to neutralize and wash out the little alkaline matter of this superficial soil. The red and brown soils, however, the produce of the Plutonic formation, are far more lasting, as they contain a good deal of rich alkaloids with more iron and manganese.

Rivers.—The only considerable rivers here are the Kaluganga and Walawe, running from S.E. to N. W.; the small streams run from S. W. to N. E. The former river is navigable from Ratnapura to the sea at Kalutara, from which place there is a canal to Colombo, which will materially assist the transfer of ores and minerals to Colombo.

From the commencement of my researches, I felt convinced that I should succeed in meeting with mines of iron, tin, manganese, cobalt, nickel and others; and even at the present moment, although but very partially successful, and meeting with many difficulties, I am confident of their existence both from the general features of the country and from the evidences met with. It must be borne in mind that all the specimens, or even larger quantities of metals hitherto collected, have been simply taken from the

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surface; no attempts having to this time been made at excavating, there being not one mason or stone-worker in the district, nor a stone building of any description except the ancient temples.

Iron.—The varieties of iron met with are six in number: viz., magnetic iron ore, titanate of iron, chromate of iron, iron with manganese, iron pyrites, and yellow hydrate and red peroxide of iron. The iron, however, in most of these is scanty, and the ore of little value except to extract the chrome and manganese. But there is another description of ore found in vast abundance, brown, compact, generally in the state of carbonate, though still blinded with a little chrome, and often with molybdena. This occurs in large masses and veins, one of which I believe extends for a distance of fifteen miles. Of this, millions of tons might be smelted, and when found near water-carriage and fuel it may be worked to a profit. I would lay particular stress on the very fine quality of the iron ore found in Ceylon; it is easily smelted, and so pure when reduced, as to resemble silver. The rough ore produces from 30 to 75 per cent—on an average fully 50 per cent; the iron wrought from it requires no puddling, and steel thus made cuts glass like a diamond. From calculations carefully made, the metal could, I think, be laid down in Colombo for about £6 per ton, and this, supposing the ore had to be brought thither for smelting and even prepared with English coal; but anthracite, being found on the spot, could be used in the proportion of three to one of English coal, and much cost saved.

Remains of ancient smelting furnaces are met with in all directions, precisely similar to those now in use amongst the natives. The Sinhalese never go to any trouble for the ore required; they seek a spot where the last rains have loosened the soil, and there break out a sufficient quantity, which is prepared in a couple of hours by the most simple means. None of their furnaces can reduce more than twenty pounds of ore, and this yields from seven pounds to ten pounds of good metal.

Manganese is also found in considerable quantity, though not in such abundance as iron, and the low price of the article does not hold out any inducement to work it.

Chrome is met with mostly as chromate of iron. It is found also of similar character to that of Baltimore and the Ural. It might cost, when brought to Colombo, three pence per pound, whilst the value in England is represented to be about nine pence.

Nickel, in the form of an arseniate, is found interspersed with many other ores in the alluvium of this district; it exists in small flat pieces resembling copper. It might be profitably exported to China, where it is of value as a colouring matter. Nearly in the same state and quantity, and in similar positions may be found *Cobalt*, another base of a fine colour and of value.

Tin.—The tin ores are also found in the alluvium just below the strata of precious stones. The locality most favourable for the existence of tin is decidedly in the eastern side of the district along the base of the high mountain zone, and especially near the Edelgassina Pass. To work tin mines here with success, it will be necessary, I anticipate, either to reduce the height of the rivers or to employ powerful pumps in each mine, so plentiful is the water and at so high a level. The position in which this ore has been met with is precisely similar to that of the ore in Saxony and Siberia, with tourmaline, white topaz, zircon, garnet, and corundum.

Titan and *Wolfram* ores are likewise found in the alluvium and in the iron and tin ores. They are used in porcelain manufactures as colours forming a rich brown, a steel green, and steel yellow.

Molybdena.—Next in abundance to iron exists molybdena in the Sabaragamuwa district. It is to be met with dispersed through all the varieties of rocks and throughout the alluvium in small grey scales, so nearly resembling plumbago that it is commonly taken for it. It is chiefly found in a state of bisulphuret in the Cambrian and Devonian strata. The ore was used in the

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Sixteenth Century for the manufacture of pencils, and at a later date to assist in working brass, bronze, and iron for statues, &c.; but it has been hitherto found so sparingly, and the price has been so high, that it has never been in general use. It might be obtained in large quantities in the neighbourhood of Kullurta, Godagamuwa, Bullutota and Komdrugalla.

Tellurium.—The very rare and valuable metal called tellurium is also to be found in these vicinities. It has only hitherto been met with in Transylvania and the Ural mountains; it is used for chemical purposes only, and not long since bore the same price as gold in Europe.

Plumbago or *Graphite* is found chiefly in the southern side of Sabaragamuwa, in the Kukulu Korale. It is believed to belong to the same formation as the anthracite, viz., to the upper strata of the Devonian formation. The principal mine is at Nambapana, and contains a large vein running from N. W. to S. E. The ore is pure and crystalline near the basalt, and compact and massive further from it. I believe that this vein extends to a distance of forty or fifty miles towards the Bintenna country. The plumbago of Ceylon is pure and light, and now that a method has been discovered to purify and to compress it, the value will rise, especially as it is now required in the new process of smelting ores by galvanism. For this purpose it might prove a valuable export to South Australia.

Anthracite may be found in precisely similar situations with plumbago. Indeed, whilst the latter is the metallic carbon, the former is a hydrate of carbon. Just as plumbago is found near the basaltic eruptions, so is anthracite found. Both contain the same foreign substances, viz., quartz, alumine, magnesia, titan, chrome, manganese, and iron. It is my opinion that this substance exists as abundantly as does plumbago. I recommend exploring the country for it near the Bentota river, half-way between Galle and Colombo, and I believe that it might be produced for 18s. the ton, whilst English coal cannot be laid down under 28s. It is recommended to burn half anthracite and half coal, and now that large quantities of fuel are monthly required by the steamers touching at Point-de-Galle, this becomes a subject of importance.

Nitre has long been known to exist in Ceylon, and Davy in his account of the island describes it and its localities. I think that it exists in sufficient abundance to form an article of export, and that it would be good policy on the part of the Executive to encourage any undertaking of the sort by liberal terms of renting the spots found to contain nitre. The localities where the production is met with appear to be very similar to those in Brazil. In Sabaragamuwa there are about sixty caverns, varying in extent from 100 to 200,000 cubic feet. The abundance of wood to be found near these spots would appear to favour the lixiviation of nitre, and, by their being situated within short distances of water conveyance, the produce could be economically conveyed to Colombo for purification and shipment.

Kaolin is met with in great abundance throughout the district, varying in quantity from small strata to large rocks, and also in all degrees of purity. The cheapness of this article in Europe alone prevents it from becoming one of great value for export. The best earths yield from 40 to 70 per cent of the pure article. It makes a ware very similar to the Wedgewood, when well prepared; and a superior kind of tile capable of receiving all colours might be formed with it, especially as we have around such abundance of colouring materials for imparting any tint required. The coloured tiles found in the Moorish palaces in Spain are of this earth, and they are as fresh now as when made. The vicinity of anthracite to burn them, and navigable rivers for their conveyance, are all in favour of the manufacture, which would be infinitely preferable to the common porous bricks now in use in Ceylon for floors of dwelling-houses, both as regards appearance and healthiness.

Stratite, or French chalk, is found, but not very pure nor in great abundance.

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Limestone is found abundantly.

Marble may be met with, but not of great purity.

So rich is the soil of many parts of Ceylon in precious stones, that despite the explorations which have been carried on for so many centuries, there is still an incredible quantity in Sabaragamuwa. They consist chiefly of the ruby, blue and yellow sapphire, chrysoberyl, topaz, tourmaline, spinel, garnet, cinnamon-stone, and opal. Amongst all these the proportion of really valuable stones is comparatively small; still many are to be found of great brilliancy and beauty.

Great number of persons of very indifferent character employ their whole time in searching and gambling for precious stones, and the villagers are addicted to it to an excess which interferes prejudicially with the cultivation of their paddy and other lands. It is a pursuit in every way hurtful to the character of the people generally, and the district would benefit much could the search be kept as formerly in the hands of a licensed few. It is estimated that from this district alone, exclusively of a large demand within the island, stones to the value of £4,000, or £5,000 are annually exported, of which Government receives no share whatever.

From the low state of civilization of the natives, they cannot be expected to take any active part in the development of the mineral resources of the country. Their dislike to labour is painfully manifested, and is not likely to be overcome so long as they can obtain a living by searching or gambling for precious stones. Whilst this source of subsistence is left to them, they will not trouble themselves to undertake any mining operations, and it can only be by the aid of European industry, energy, and skill, that the natural wealth of this district is ever likely to be opened up. But it is not the people alone who prove obstacles to mineralogical researches and labuor; the country itself, from its very nature, offers impediments of a serious kind the luxuriance of the vegetation, even amongst the most rocky parts of the district, renders correct and continuous examination of the face of the country tedious and difficult. But the greatest impediment to mining operations will prove to be the high level of the rivers, especially of the Kaluganga; and until this can be reduced, which it may be by blasting rocks at the various falls, we cannot hope to prosecute such operations successfully, or at least not to any practical extent. The most encouraging portions of this district for minerals appear to be the eastward, where there is great promise of plumbago, anthracite, and iron. As to lead and copper, these ores might be more reasonably looked for there than in the higher range of mountains; and tin ore, as has been before remarked, appears to be met with in quantity towards the higher zone near the Edelgassina Pass.

In the course of my explorations a number of resins and colouring articles have been found, of an entirely novel character, and some likely to prove of commercial value; but as yet sufficient time has not elapsed to allow of their being carefully analysed—a process which is now occupying my attention, and which in this country, where the means and appliances are not abundant, proves often a most difficult and tedious undertaking.

RUDOLPH GYGAX.

Colombo, 30th June, 1848.

GEMS IN SABARAGAMUWA.

(*Extracts from a Report made by Mr. F. R. Saunders, Assistant Government Agent, Ratnapura, to the Government Agent, Colombo, in* 1867.)

I have the honor to report, that so far as I can ascertain, regular gemming by pit-digging has never been freely and openly allowed on Crown land, though in remote districts very little attention has been paid to the mere washing of gravel or blasting of rocks in streams in search for precious stones.

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There were some very valuable pits at Weralupe, which originally were claimed and held by the Temple, but when the land was "rejected" by the Temple Land Commissioner and taken over by the Crown, the Government Agent called on his Assistant to stop the gemming operations, and to assert the rights of the Government.

These pits were afterwards sold, but close to the stream and adjoining the Assistant Agent's house there are still some gemming grounds which are considered valuable. A short time ago it was brought to the notice of my predecessor, Mr. Russell, that parties were again gemming in these pits and streams. He then issued the general order complained of by petitioners, and I have caused that order to be strictly enforced.

The question as to whether or not it would be advisable to derive a revenue by leasing the right to gem on Crown lands has before been brought to the notice of Government, and having read over the correspondence, I do not find the reasons urged against such a proceeding to be so convincing as to prevent me from expressing my opinion in favour of the suggestions made by Messrs. Mitford and Mooyart, and I most strongly recommend that the right of gemming on Government lands should be annually leased. In this I differ from the gentlemen aforenamed, that I recommend an annual lease and not a collection of revenue by license tickets.

It appears to me that to altogether prevent persons gemming on waste lands and in public streams, unless the Government intend to prosecute the search for gems themselves, is to conceal the resources of the country and to prevent the development of a trade, which is, I consider, capable of very great extension.

From enquiries I have made, I find that about £4,000 to £5,000 worth of gems are exported from the Sabaragamuwa district each year, and there can be no doubt that many of these gems are found in public streams and on waste lands. It is calculated by those who are qualified to judge of such matters, that if any person bought the right to gem on Crown lands, and could conduct his operations openly and not as at present by stealth, that he would realize at least £3,000 a year. When persons owning land on which gems are known to be found give gemmers the right to search, they exact a proportion varying from one-third to one-fifth of all the gems discovered. Taking this as a standard, the right to gem Crown lands in Sabaragamuwa should rent for about £700 or £800 a year.

This calculation, though in excess of the estimates made by Messrs. Mitford and Mooyart is under what I am led to believe the rent for 1868 would realize, and unless I have been greatly and purposely mis-informed, the figures I quote are under the general estimates made by persons possessing practical knowledge of the matter.

The agent here of the principal jeweller (Assena Marikar or the Gem Notary) tells me that the rent would fetch more than £1000 a year, and that he himself would be inclined to offer £500 a year for the right to gem in one stream alone (the Niwitigala River).

But the rent of the first year would probably be far less than would be obtained in after years, for it would soon become known what sums had been realized and what spots had produced stones of any value. I doubt not that offers would be made to buy some of the lands, whilst the value of the right to gem would not be diminished, for each year new pits would be sunk and fresh discoveries made.

In 1866 Mr. Birch sold 1 ½ acres of such lands (close to the Asst. Govt. Agent's house) in lots, and realized £420. One lot of 17 perches or 22 yards square fetched the sum of £117 15s, and I am told by a shareholder in this purchase, that the purchasers sunk two pits in the land (which is large enough to contain five pits), and in last year realized over £300, and cleared

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£200, by the gems discovered. Could these lands be sold or rented, now that their value is known, the 1 ½ acres would fetch nearly three times as much as they originally sold for.

That stones of very large value are occasionally found is established beyond doubt. Iddemalgoda Basnayaka Nilame who has given me much information on this subject, tells me that in one of his pits was found a sapphire that he sold for £800, and it was re-sold in India for £2,000. Another sapphire found in the stream near the Assistant Agent's house was the subject of dispute, and was sold for £200 to Iddemalgoda. He sent it to Colombo and sold it for £365, and it has probably since then fetched three or four times that sum in India or Europe.

Four months ago the Gem Notary sent to London to be forwarded to the Paris Exhibition, a sapphire found in the Weralupe pits which, after much haggling he had bought from his fellow-shareholders for £650. This stone, which uncut, is said to be the size of a hen's egg, has been valued in Ceylon at £2,500, and it is impossible to guess what may be its value in the capitals of Europe.

All these stones were found in the Weralupe pits, whilst the temple claimed the land and before it was sold, and it shews of what wealth the Government was defrauded during the temple usurpation, though such wealth is, of course, valueless, if left in the bowels of the earth.

I beg therefore again to urge upon the consideration of Government, how desirable it is that some system should be adopted for developing the resources and trade of the district in this particular direction.

Solely as an experiment, I would ask permission to divide the district into parcels; and rent the parcels by public auction, the upset prices being fixed according to estimated value. Should the prices thus realized not be considered sufficiently good, the rent of the whole might be exposed in one lot at an upset price to be hereafter determined, and if the expectations of Government were not then realized, the rents might be withdrawn and persons most strictly prohibited from gemming on public lands for the future. My opinion is that leased in parcels the rents would fetch £1,000: due notice will be required to be given to the jewellers of Galle and Colombo.

The rents should be sold in November or December to take effect from 1st January of each year, and the renters should be required to conform to regulations guarding against destruction of timber or other Government property, whilst they are prosecuting their search for gems.

I am sir (Signed) F. R. SAUNDERS, Assistant Government Agent.

(*Note* 1881.)—The value of gems exported from Ratnapura has increased very much since 1867, and Government now lease lands at profitable rates, though there is no regular system or law to regulate the digging for gems on Crown lands.

PRECIOUS STONES AND GEMS.

(From "*Precious Stones and Gems,*" *by Edwin W. Streeter.*)

The amethysts of the Palatinate fairly rival in beauty those found in Ceylon or Brazil. It is not the geographical position which determines the difference, although it is acknowledged that India, Brazil and Ceylon have produced larger precious stones and in greater abundance than other lands. The ancients were wont to ascribe this pre-eminence to evaporation from the earth where precious stones are found—an evaporation obviously more intense in tropical countries. It is as if the sunburnt tropics were more favourable to the blossoms of the inorganic world, than the dark skies of the north.

But although precious stones are not limited to any defined geographical area; their distribution is in a measure circumscribed. They are not met with

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in all mountain ranges, nor in all formations of mountains. The most valuable are found in such ranges as are considered the oldest in the world: such as are composed of granite, porphyry, and mica-slate. Sometimes they occur imbedded in the mass of the rock; at other times, growing, as it were on the surface. When they are thus found in the very rocks where they were originally formed, they are said to be in their primeval bed. Many, however, are found far from their primal home in a *derivative* or secondary bed, in diluvial or alluvial soils, and in the gravels and sands of river-beds. This last mode of occurrence is the most frequent for the finer precious stones. Far removed from their native home by the force of heavy rains and rushing torrents, they have been loosened and carried onwards, rounded by friction against the debris with which they have been accompanied in their course. It is by their hardness and density that they are preserved, and many even retain traces of their original crystalline form.

In Ceylon, India, Brazil, Australia, California, the Ural, Siberia, and South Africa—from which countries the great majority of our precious stones are obtained—the most usual way in which they occur is in these derivative beds; and it is interesting to notice how various kinds of precious stones are found in the same locality, forming as it were a noble society of gems, stil more illustrious by their association with gold and platinum.

The trade in precious stones is much more important now than formerly. Before the discovery of America, India was the great emporium. Pegu, famous for its beautiful gems of all kinds, received yearly a very large sum for its exports. So also did Ceylon, from which island we even now obtain a large portion of our coloured precious stones. During the dynasty of the Kandyan Rulers, the right of digging for precious stones was most jealously guarded as a royal prerogative, and the inhabitants of particular villages under the supervision of hereditary overseers were occupied in the search for gems. Under the British Government this monopoly was given up, and traders needed no "special permit."

A number of men are constantly employed in this exciting and precarious business; and the idle and disorderly adventurers who visit the villages are the cause of great immorality among the inhabitants. The results of their labours they sell to the Malays who come to Saffragam with cloth and salt, which they exchange for precious stones. At the yearly Buddha festival, there is a jewel market held in Ratnapura, whither those interested in jewels flock from all parts of Ceylon.

The position of the people in Saffragam is so much improved of late years that they are able to retain any stones they find of great worth for themselves. Now and then they are induced to exchange them for gold, which they can easily, well conceal. The artificers who cut and polish the stones on the spot are generally Malays: but their work is so imperfect, and their knowledge of the art so faulty, that the stone positively loses by passing through their hands. Stones of smaller value, such as cinnamon-stone, garnets and tourmaline are cut and polished by ordinary workmen in Kandy, Matara, and Galle. Artistic and experienced workmen who cut rubies and sapphires live chiefly in Kalutara and Colombo.

As a general rule, the rare gems are cheaper in Europe than in Colombo. Precious stones are brought from all parts of the world to London both in the rough and also to be re cut. In Ceylon the stock is so uncertain, that the price is largely determined at the moment by the rank and wealth of the buyers. The small Malay dealers do not buy rare and fine jewels, knowing quite well that the best and finest specimens are carefully held back by the rich traders, who can always ensure a high price for the best Ceylon stones from the native princes of India, who have an ardent passion for gems of conspicuous beauty or size.

It is quite impossible to judge accurately by the Customs' Register in

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Ceylon of the worth of the precious stones which are sent out of the island. Only a small part is sent to England. The rest are bought up by private hands, but these ultimately find their way into the English market. It is calculated roughly, however, that the value of the precious stones found in the island is £10,000 yearly.

It is said that the Dutch East India Company formerly received the rough stones in packets, sealed with their special seal. Those packets were sold by auction, without being opened. Often from 20,000 to 30,000 florins were paid for one packet, and the buyer was very rarely wrong in his purchase.

Sapphires and Rubies.

The prominent forms of crystallization are the six sided prism and the hexagonal pyramid. The predominant colours are blue and red.

Sapphires are azure blue, indigo, ducks-neck colour, violet-blue, poppy-red, cochineal, carmine, rose-red to rose-white, milk-white, yellow white, French-white, lemon-colour and green. As a rule, the colours are pure and high. Sometimes a crystal is found exhibiting a variety of colours. The asteria or star sapphire shows, under the miscroscope, thread-like shafts directed towards the faces of the six-sided prisms, said to be spaces left at the moment of crystallization, and it is the reflection of light from these which give to the stone its star-like brilliancy.

The blue variety is called sapphire in its limited sense.

The red variety is the ruby.

Other varieties deserve notice, such as spinel, garnet, zircon, etc.

The finest rubies and sapphires are found in largest quantities in Burmah, at Mo-gast and Kiat-pyan, five days' journey from Ava.

The small sapphires of Ceylon are well-nigh all of a rose-red. They can be obtained easily from old collections, as they were formerly used officially. They are so clearly crystallized that they are easily distinguished from spinel, which often accompanies them. Those found in Ceylon, Siam, and other eastern countries are remarkable for their colours. They are found like rolled pebbles in channels of rivers, and the colours run through green, red, yellow, and black. Bertolacci affirms that "the brilliancy and beauty of those in Pegu far exceed that of those found in Ceylon."

At the foot of the Capelan Mountain, near Sirian, a city of Pegu, and in the vicinity of Kandy, corundum is also found in the detritus of granite, magnetic-iron, zircon, &c., all having been probably washed down from the granite mountains.

In Ceylon the sapphire is common, the ruby very rare; but the converse is the case in Pegu.

There are famous mines of rubies at Badakshan in Usbekistan, a part of Tartary. The mines were known to the Emperors of Delhi. They are near the Oxus, near Shunan. There is a belief among the natives that two large rubies are always near together: thus it is that the fortunate finder of the one hides it until he has found the twin like it; failing this, they will often break a large one in two. There is a belief also that the ruby is the product of the transformation of limestone, and that it is found in the form of pebbles. Near to the ruby mines a great quantity of blue felspar is obtained.

Corundum (proper) and Diamond Spar.

The mineral generally termed corundum is found in crystals with rough planes as a rule, and in individualized masses of a particular cleavage. The rhombohedral form occurs as in the former varieties, but here only in combinations. The fracture is uneven. The colours, generally dull, are of greenish-grey, greenish-white, asparagus tint, oil, pearl grey, flesh or rose red sometimes of a chestnut brown. It has only an inferior degree of trans parency. The last-named variety comes from China, and because a peculiar

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bluish light occasionally plays upon it. Werner called it "Diamond Spar." It is said that some crystals found near St. Gothard, exhibit two colours, and that some of these are in dolomite, but more commonly they are found in mass. Some in Styria have grown in with the granite, and so firmly that it is difficult, if not impossible, to remove them without damage. The crystals may be from the size of a pea to that of a hazel nut, of a greenish-blue or duck's-neck violet. Some pieces display several colours. In Bohemia they are found embedded in pebbly masses of hercinite. In Rhodes, Sweden, and the Urals, they may also be found with tourmaline in schist, with platinum and magnetic iron ore. In Ceylon, China, and India, they are found in beautiful green crystals, possessing characteristic stri pes, with black hornblende.

PLEONASTE.

This mineral received the name of ceylanite from Rome d' L'Isle, who analyzed it with a number of others brought from Ceylon. Haüy, seeing its crystal was like that of the spinel, desired to give it a special position in the system of minerals, and named it *pleonaste*, which signifies superfluity. Further investigation shewed that it was in reality a black variety of the spinel.

The specific gravity of this stone rises from 3·5 to 3·8. It consists principally of alumina, and about 10 per cent of protoxide af iron. Its infusibility before the blow-pipe, and its formation with borax into an iron-coloured glass, are the surest indications of pleonaste. Acids have but little influence upon it. It is found in Russia and other cold climates, but it is also found in Ceylon, as well as in the dolomite region in Ratan.

Spinel, in consequence of its lustre, colour, and hardness, is used for personal ornament, and for objects of luxury; but it is only when the crystals are fine and large that they are considered gems. In cutting, it receives the same form as the ruby.

Spinal ruby for balas ruby varies in value according to its cut and colour.

In the inventury of the French Crown Jewels, in the year 1791, we find the following;—

One spinel ruby of	56¼	carats	...	50,000 francs.
One "	4¾	"	...	300 "
One "	3¼	"	...	300 "
One balas ruby	20⅜	"	...	10,000 "
One "	12⅜	"	...	3,000 "

At the present time, small stones range from 5s. to 10s. a carat.

Medium stones of fair colour 20s. to 40s. a carat.

Large stones 60s. to 100s, a carat.

Specimen stones attain even a higher value.

THE CAT'S-EYE.

Much confusion exists concerning this very curious and valuable gem, a confusion arising partly from the ignorance of many in the trade as to its true nature, but principally from the mistake of those who have written about it. In mineralogical treatises it is usually confounded with, and described as a particular variety of quartz, which somewhat resembles it, but which is of little or no mercantile value, although it has occasionally been sent to Europe by unscrupulous merchants as the true cat's-eye. This *chatoyant* quartz is found in Ceylon (also the home of the *true* cat's-eye) in large quantities, and occurs chiefly of various shades of yellow or brown. It is semi-transparent, and when cut in a convex form (*en cabochon*) shews a more or less defined band of light with a *silky* lustre, resulting from a reflection of the fibrous-like grain of the stone itself, or more probably from an intimate admixture of asbestos. This quartz cat's-eye, even when most perfect, cannot be compared for beauty with the real cat's-eye, for which it would not be mistaken, even by the uninitiated. It is at once distinguished by its inferior hardness and want of brilliancy,

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Description of true chrysoberyl Cat's-Eye.	*Description of quartz Cat's-Eye.*
Color—Various shades of yellow, brown, and green, rarely black.	Color—Various shades of yellow and brown only.
Ray—Iridiscent.	Ray—Dull.
Polish—Brilliant.	Polish—Dull.
Hardness—8·5.	Hardness—6 to 6·5.
Specific gravity—3·8.	Specific gravity—2·65.
Infusible and not affected by acids.	Melts with soda to a clear glass. Soluble in fluoric acid.
Sometimes shewing a beautiful trichorism.	Never trichoric.
Chem. Com. — 80 alumina, 20 glucina, colouring matter—protoxide of iron.	Chem. Com. — 48 silicium, 51 oxygen, with a small amount of oxide of iron and lime.

The true cat's-eye is a rare variety of the chrysoberyl, of extreme hardness (in this respect being only inferior to the diamond and the sapphire), and is characterized by possessing a remarkable play of light in a certain direction, resulting it is supposed from a peculiarity in its crystallization. This ray of light, or "line," as it is improperly termed by jewellers, shines in fine and well-polished specimens with a phosphorescent lustre.

The cat's-eye comes principally from Ceylon, where it is found with sapphires, and is met with of various colours, ranging from pale straw-colour through all shades of brown, and from very pale apple-green to the deepest olive. Some specimens, much sought for by Americans, are almost black. The line, however, no matter what ground colour the stone may possess, is always white, and more or less iridescent. This lustre is most beautiful when seen in full sun-light, or by gas-light, when the line becomes more defined and vivid.

This gem is valued principally according to the perfection and brilliancy of the line, which should be well-defined, not very broad, and should run evenly from end to end across the middle of the stone. The colour does not influence the value much, some jewellers preferring one tint, some another. On the whole, perhaps the most popular colours are the clear apple-green and dark olive: both of these form a splendid background, and contrast well with the line. It is quite impossible to give any satisfactory scale of values for this gem. Its estimation depends much on personal appreciation and taste: a ring-stone may be worth from £10 to £100, or even more; and there are large specimens at present in the market which are worth upwards of £1,000.

The cat's-eye has become more and more fashionable of late years in Europe, and its value has greatly increased.

In India it has always been much prized, and is held in peculiar veneration as a charm against witchcraft, and is the last jewel a Sinhalese will part with. The specimens most esteemed by the Indians are those of a dark olive colour, having the ray so bright on each edge as to appear double. It is indeed wonderfully beautiful with its soft, deep colour, and mysterious gleaming streak ever shifting, like a restless spirit, from side to side as the stone is moved; now glowing at one spot, now at another. No wonder that an imaginative and superstitious people regard it with awe and wonder, and, believing it the abode of some genii, dedicate it to their gods as a sacred stone.

Star-Stones, or Asteria.

The Orientals had, and still have, a deep veneration for star sapphires.

The localities of star-stones are the same as those of other sapphire crystals.

When light shines upon these stones, stars of six rays are seen, an appearance which attracts much attention and gives proportionate pleasure. This may be termed its speciality, and is more observable when the stone is convex. The colour is a greyish-blue; occasionally blue and red specimens are met with.

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The star-stones, according to their colour, are designated star ruby, star sapphire, or star topaz.

Only of late years have they been of any value in England. In Ceylon, but a few years back, they could have been purchased for a few shillings, as the natives had but little regard for them. The finest star ruby I have seen was valued at £200, and is in the possession of a private gentleman, who obtained it from a noted collection. If a pair of these stones could be obtained, their value would undoubtedly be largely augmented. The price of these gems is mainly determined by their size and quality; small star sapphires range from £2 to £10; large sapphires £10 to £100. Star rubies obtain higher prices, but star-stones, of a secondary rank, are of little or no value.

The River Sangaris (according to Plutarch) produces a gem called aster, which is luminous in the dark, and called by the Phrygians "Ballen," "The King." A gem called "Asterites" found inside a huge fish called "Pan," from its resemblance to that god, is also described by Ptolemy hephæstion. This stone was a potent love-charm, and when exposed to the sun shot forth flames. It was used by Helen of Troy for her own signet, and to it she owed all her conquests. Helen, however, was not of human origin simply, and her beauty was as great at seventy as at seventeen. The term asteria has been used by different authors in various senses at various times; but Pliny understood by it the same gem that we do at present. The star sapphire is also known under the title of astrapia (lightning stone), from its supposed action in a colourless or an azure ground, sending out, as it were, rays of lightning diverging from the centre.

Asparagus or yellow-green chrysolite was known in very early times to the people of Ceylon and Brazil. In Ceylon it was found in the sand of the river in company with tourmaline, spinel, and sapphire. On the east side of Borneo also, it is found in the river sand, and in flooded lands with crystals, gold dust, diamond, topaz and emerald. In Pegu it is found amongst pebbles and loose river sand. In Brazil, pieces of this chrysoberyl of the size of a hazel nut, and of yellowish-green colour, are sometimes met with while washing for diamonds. Of late years it has also been found in Connecticut, North America, in well-formed tables and prisms, with tourmaline, garnet, and beryl, in the granite strata; and at Saratoga and Greenfield in New York State, in regular twin crystals with tourmaline, garnet, and spatite.

The Garnet, Carbuncle, Jacinth, and Cinnamon Stone.

The garnet or carbuncle was a great favourite with the ancients. Several antique garnets have been found in Roman ruins, some being round, and some cut; the latter receiving the name of "Garnet Plates," the underside of which is ground convex, to give them a more perfect transparency. In former days it was very frequently engraved, and several beautiful specimens are now to be seen in Paris, Turin, Rome, and St. Petersburg; among which is the grand masterpiece of art, the representation of "Sirius," engraved on the celebrated Marlborough garnet. The small degree of hardness possessed by this stone renders engraving on it comparatively easy.

The word garnet, or, as the Germans call it granat, owes its origin to the similarity in colour to the blossom and kernel of the pomegranate, a fruit of Southern Europe; it is not a name of ancient date. Pliny calls it "Carbuncle" from "Carbo," a live coal; both names are derived from its bright red colour. According to some authorities, however, it is thought that the origin of garnet is "Graniun," a grain, because it is so often found in that condition. The precious garnet is sometimes called "Almandine," from the city of Alabanda, in Carien. Its colour is blood-red, cherry, or brownish-red, which, unlike the American amethyst gains nothing by candle-light. On the contrary, it assumes an orange-tint, which detracts from its beauty. The crystals are almost always embedded in the rock singly. Its specific gravity is from 4 to 4·2, and its hardness is 7·5. It possesses a bright lustre, and is transparent. It occurs very

frequently mixed with a variety of other stones, and the places where it is found are so numerous, that only a few of the most important can be mentioned.

In Hindustan, garnet is abundant in the debris of mountains; and in Ceylon it occurs everywhere in gneiss, particularly at Trincomalee and at Adam's Peak

The jacinth, sometimes called hyacinth, is an orange-red variety, it differs in some respects in character from the deep red garnets, and is considered by lapidaries as a distinct stone. This is a mistake, as its crystalline form and typical composition are identical with that of the other garnets. Its chief difference, besides its peculiar colour, is a lower specific gravity, and the presence of 30 per cent of line in lieu of protoxide of iron. The specific gravity is 3·65. It is known to mineralogists as the essonite or cinnamon stone.

Jacinth, or cinnamon stone, comes almost entirely from Ceylon, where it is found in large pieces in the strata of rocky mountains; these stones are generally finely coloured and transparent. They are cut thin on account of the depth of colour, with a pavilion-cut below and a broad table above, bordered with small facets.

Rock crystals are found in a variety of forms, sometimes of extraordinary size. Their colour varies from pure white to greyish-white, yellow-white, yellowish brown, clove-brown, and black. They possess double refraction and transparency. The electricity obtained by friction lasts about half-an-hour, rarely longer except under very favourable conditions. Before the blow-pipe many coloured crystals lose their tints. The frequent admixture of chlorite, asbestos, rutile, iron pyrites, gold, and radiolite in the crystals is very remarkable. The green colour of the last is like a blade of grass inclosed in ice. The liquid or gaseous contents, which move as you turn the crystal, are very interesting.

Ceylon affords it adbundantly, and the natives use it for ornamenting their temples.

THE TOURMALINE.

Tourmaline, known in Saxony as "Schorl," from the name of a village where it abounds, is mainly composed of alumina, silica, and boracic acid, although there are specimens which contain a small quantity of iron and manganese. The crystallization is rhomboidal; its cleavage is imperfect, and its fracture conchoidal. It is very brittle. Its hardness is 7 to 7·5, and its specific gravity 2·9 to 3·2. Tourmaline is rarely found of pure-water. Its colours are very varied, consisting of shades of greys, yellows, greens, blues, and browns; they all have a tendency towards the darker hues, even to black. A black or red kernel is not infrequently found in the midst of the stone.

Tourmaline possesses double refraction. Some specimens polarize light perfectly, and by the aid of the polariscope it is easy to detect the pure gem from the yellow and green specimens.

Tourmaline, in common with other precious stones, developes electricity under friction, and is a mineral of the greatest interest from a thermo-electric point of view. Its dust is attracted by the magnet.

The Dutch introduced tourmaline, somewhat more than a century ago, into Europe from Ceylon.

The yellowish-green tourmaline (Ceylon chrysolite) is very like aquamarine, and is found in the river-beds of Ceylon and Brazil. Colourless tourmaline occurs very seldom in pieces worth the cutting and polishing. The most beautiful specimens are found in Elba and in dolomite mountains. Brown tourmaline is a variety not used for ornament. Ceylon and Switzerland yield a fair supply.

The value of the tourmaline depends upon the colour, quality and size of the specimens; one of exceptional colour and purity, of five carats weight, would be worth £20.

THE ZIRCON, JARGON, OR HYACINTH.

The Zircon, jargon of lapidaries, and hyacinth, are all varieties of the same stone. Its name in Greek is "Uakinthis," in Latin "Hyacinthus," in

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German "Hyacinth," and "ein breuneder jacinth," and in French "Jacinthe la belle." We apply the term hyacinth to trasparent and bright-coloured varieties; jargon to crystals devoid of colour and of a smoky tinge, which are occasionally sold as inferior diamonds. Anselmus Boetius gives the following description of this gem:—(1st) "There are some that flame like fire, or are similar in colour to crimson or to natural vermillion, these the French jewellers call 'Jacinthe la belle,' and these they esteem the best. (2nd) Those with a yellow-red colour. (3rd) Others which are like unto amber, so that they can hardly be distinguished from it, but by their hardness. These are of no great value by reason of the atoms they contain, and the multiplicity of small bodies which are in them, which do hinder their transparency and translucency."

Little grains of zircon are found in the valley of the Iser, in Bohemia; and small violet-blue crystals are obtained from the gold sands of the Ticino, and also from Vesuvius. It is obtained from Ceylon, which is one of the richest beds of natural wealth in the world, and also from Pegu in the river sands.

PRECIOUS STONES IN CEYLON.

(From "*Ribeyro's Ceylon,*" *by George Lee.*)

The precious stones which are most remarkable in Ceylon, and which the Moors and Indians most prize, are the *cat's-eyes.* They are scarcely known in Europe. I saw one on the Prince of Uva's arm, when he came to visit us, of the size of a pigeon's egg. It was quite round and of the form of a large musket-ball. These stones are heavier than other precious stones; they are never worked up, but are only cleaned off. It seems that nature has concentrated in this one stone the finest and most lively colours which light can form; and that those colours contest with each other which shall produce the greatest effect. One colour is more prominent to view than another, according to the light in which the stone is held; and if its position is changed, another colour strikes the eye to greater advantage; on this account the stone is called a *cat's-eye,* as it has rays opposed to each other which create that variety in its appearance; as we see the eye of the cat itself change in brilliancy and effect, as the animal turns or removes it. These rays in the *cat's-eye* are never of an even number; there are three, five, or seven of them; these lines of light are called, *betas.* and the price of the stone increases according to the number of those *betas.* The rubies are the finest stones after the cat's-eyes, then come the sapphires and topazes. The Moormen attach high value to the topazes of Ceylon, because some of them are very large. These four precious stones are the most common in Ceylon; we have already spoken of some others, but they are of smaller value. There are some mountains on the island from which white, green, or red crystal is procured; and the native workmen cut it well and polish it for crucifixes, images, crosses and other emblems of religion, by means of two wheels and emery and solder.

Addition by the French Editor.

ON PRECIOUS STONES.*

Edward Barbosa, who has published a treatise on what he saw, most remarkable in the East Indies and of their chief articles of trade, dwells particularly on the precious stones of the country. He gives us their peculiar marks, the places where they are found, and their respective prices and values. He begins with the rubies and he states that the finest and best are found in the

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* From Ramusio—vol. 1. fol, 321.

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Pegu river, and that there are others in the mountains beyond that river, but of an inferior quality; yet he says that a ruby from Pegu, perfect in quality, weighing twelve carats, was only worth in his time 150 golden crowns, and he values one of Ceylon of the same weight at 200 crowns. He says also that there are some in Ceylon weighing 16 carats which are worth 600 crowns; he does not say that there are any so large in Pegu; but it does not appear that fine rubies are so common in Ceylon as there. They are assayed in this way:—when a ruby of considerable size is brought to the king, he sends for his jewellers, who tell him to what degree the gem can stand fire, and how long; these men are seldom in error; the ruby is then thrown into the fire and left there as long as they have stated, and when it is taken out, if it has borne the fire well and is of a more lively colour, it is esteemed much more highly than those of Pegu.

Two sorts of *sapphires* are also found in Ceylon; the better kind are hard and of a fine deep blue, and are greatly esteemed; but the pale blue ones are little thought of, yet they are valued more highly than those which are obtained from the mine near Mangalore, or from Capucar in the Kingdom of Calicut.

Fine *topazes* are also procured from Ceylon; when they are clear and brilliant, they are sold for their weight in gold; but when they are whitish, the Singhalese use them to make false diamonds.

Barbosa says that the Singhalese know so well how to bleach sapphires, topazes and other hard stones, that many people take them for the finest diamonds, and that a person must be an adept in this matter not to be deceived by them; and that time alone shews whether, stones thus prepared are false or not, as they lose their whiteness by wear and resume partially their natural colour. The jewellers, however, say that topazes well bleached always remain white.

Barbosa does not mention the cat's-eyes found in Ceylon; he only says that the Singhalese can counterfeit that stone perfectly.

GEMS IN CEYLON.

The following is from a European Colonist with a long experience of Rakwana. He writes in May 1881:—

From time immemorial the Island of Ceylon has been noted for its precious stones, and the greatest portion of the island, especially the southern half, is pockmarked with the pits dug by ancient and modern gemmers. With few exceptions these pits are of the most superficial character, as without adequate appliances it is impossible to keep them clear of water when they are deeper than 10 or 15 feet. The only gemmer who has used a pump driven by horse-power is Mr. C. M. C. Hassena Markar on the gemming ground near Ratnapura. The Sabaragamuwa district has always been considered to be the richest field for gemmers. In the neighbourhood of Awisawella, Ratnapura, and Balangoda, there were formerly extensive gemmings, but these have been in a great degree abandoned for other fields in the same district, and of these by far the richest has been North Rakwana, which now supplies the chief part of the sapphires, cat's-eyes and other precious stones sold in Ceylon.

The richest fields are situated on a plateau at the base of the Suryakanda and Kabaragala mountains, on the top and sides of Rakwana, and extending from the Springwood estate on the east to the Martinstown estate on the west. During the last ten years, the gemming by natives in this locality has been of the most extensive character, and auction sales of large quantities of rough gems are not uncommon. It is stated that ninety thousand rupees worth of rough gems were sold at one of the auctions, the result of gemming on one of the estates at the foot of the Kabaragala mountain.

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The deepest gemming pits in the island are those which were washed by the Gem Notary, until they could no longer be kept clear of water. These pits are upwards of 100 feet deep.

LIST OF GEOLOGICAL AND MINERALOGICAL SPECIMENS FROM CEYLON AT THE MELBOURNE EXHIBITION.

(*Collected and Exhibited by A. C. Dixon, Esq., B. Sc., F.C.S., Colombo.*)

1. Dolomite from Wattegama.
2. Dolomite from Wariapola.
3. Dolomite from Wilson's Bungalow.
4. Dolomite from Wellawa.
5. Dolomite from Kurunegala.
6. Dolomite from Alu-Wihara.
7. Dolomite, with blue spinel, from Wariapola.
8. Limestone from Jaffna.

Nos. 1 to 7 furnigh examples from country limestone which occurs in beds in the gneiss. They vary much in texture, colour and composition, but they all contain carbonate of magnesia. It is used as building stone, when burnt forms a very useful lime for estate purposes or for building. These dolomites occur in somewhat parallel beds which traverse the gneiss in a northerly direction. I have indicated their position on a rough geological sketch map sent along with the collection.

In the various specimens we have accidental minerals such as magnetite, pyrites, spinel, phlogopite, wollastonite, chrysolite and zircon. No. 8, Jaffna limestone, furnishes a very pure lime. The formation occurring in the north is probably cretaceous and equivalent to the Pondicherry beds of India.

9. Mica in nodules found in the valleys of the Dimbula district.

10. Gneiss decomposed forming the bottom layer of the gem pits.

11. Magnetite, shewing a peculiar cleavage occurring locally on Harmony estate, Pussellawa.

12. Limonite (Botryoidal) occurring under the cinnamon sand in the Negombo district.

13. Iron conglomerate still in course of formation in various ravines of the island. It occurs in very extensive patches; such a deposit subjected to decay would form a rock resembling our laterite.

14. Iron ore from Nuwara Eliya.

15. Gneiss containing nodules of iron from Kottagala.

16. Gneiss (garnetiferous) from Horape quarry, near Mahara.

17. Gneiss (ordinary) from Mahara quarry, the stone from which is used in the construction of the Colombo Breakwater.

18. Gneiss from Mahara.

19. Gneiss with green felspar.

20. Laterite or cabook from Colombo, quarried very extensively for building purposes.

Case II.

21. Graphic granite from Balangoda, so called because the quartz, one of its constituents, stands out prominently resembling an inscription.

22. Syenitic gneiss from Hokawela, Matale, Railway. The ordinary blue gneiss can be seen passing into this altered variety. It closely resembles Peterhead granite.

23. Jasper (crude) from Balangoda, an impure opaque form of silica.

24. Gneiss from Petiyagala, with molybdenum.

25. Sandstone from Talpitiya, a recent breccia taken from 300 yards from shore at a depth of 25 feet. The particles of sand are held together by a calcareous cement.

26. Plumbago found in veins in several districts. Large specimens are sent from a commercial point of view.

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27. Quartz (crystalline) with plumbago from Diatura.
28. Hornblende rock from Madola, Saffragam.
29. Mica found in considerable quantity in pockets in the decomposed gneiss.
30. Hornblende rock from Wattegama, Matale Railway.
31. Decomposed gneiss from a depth of 20 feet from Labugama. The felspar of our rocks, when subjected to action of water, soon decomposes.
32. Kaolin from Maturata, also found largely at Nuwara Eliya. It makes a very fair procelain.
33. Gneiss decomposed from Pallekande. The green colour is due to epidote and chlorite.
34. Iron pyrites from Nambapana.
35. Smoky quartz from Medakanda, Balangoda.
36. Calcareous Tufa (Panugal of the Sinhalese). This is a deposit of carbonate of lime from the hot springs of Bintenna. It is burnt by the natives of the district and used to chew with their betel.
37. Sandstone from Pamunugama, a recent formation occurring on the sea coast from Negombo to Mount Lavinia. The black crystals are magnetic iron. The particles of sand are tied together by calcareous matter.
38. Sandstone from Pamunugama, another variety.
39. Gneiss from the top-most rock of Adam's Peak. It is very quartzose and agrees in the main with the common rock with the island. It is upon this that the sacred foot print is placed to which so many thousands of pilgrims resort annually.
40. Rock crystal from Ratnapura.

Case III.

41. Sapphire (crystals) Nil-padiyan.
42. Sapphire, Sudu-nil.
43. Sapphire, Otu-nil.
44. Sapphire, Nil-Kanti.
45. Star Sapphire.
46. White Sapphire.
47. Ruby, Ratu-keta.
48. Amethyst, Oriental.
49. Corundum.
50. Topaz.

Nos. 41 to 49 represent the sapphire family which crystallizes in the hexagonal system. The numerous members of this group are divided according to colour, hardness &c. Thus, when blue it is called sapphire; red, ruby; purple, amethyst; when it lacks transparency and is of dull colour it is known as corundum.

No. 44 is partly blue and partly red.

No. 43 partly blue and white. The Sinhalese can by heating such with lime distribute the colour evenly through the stone, or with greater heat can discharge the colour and so imitate the white sapphire.

No. 45. on account of lamellar structure when cut in convex form shews a star of 6 rays.

No. 48 is the oriental amethyst so-called in order to distinguish it from the quartz amethyst.

Green corundum is known as the oriental emerald and yellow as topaz.

51. Spinel (crystal).
52. Spinel— a very abundant mineral, crystallizes in the cubic system generally in octahedrons or duod-cahedrons, specific gravity about 3·5 while the ruby is 4, and the garnet 3·8.
53. Garnet (Kurundugal).
54. Cinnamon stone (Essonite) a kind of garnet.
55. Garnet.
56. Tourmaline, Pachcha-toramalli.
57. Tourmaline, Peni-toramalli.
58. Tourmaline.

Tourmaline is very abundant, both crystalline and massive. It is of various colours and crystallizes in the hexagonal system.

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59. Peridot of Ceylon.
60. Chrysoberyl, the true cat's eye—an ordinary kind of cat's-eye is quartz when cut *en cabochon.*
61. Pleonaste, a kind of spinel.
62. Zircon, very abundant in Ceylon, crystallizes in the terragonal system; disregarded by the Sinhalese except the white variety which is cut and sold as Matura-diamond; often however, Matura-diamonds are rock crystal.
63. moon-stone, a pearly variety of felspar, quartz, and selenite are often cut and sold as moonstone.
64. Steatite or soapstone, a massive variety of.
65. Quartz (teruwana).
66. Quartz (crystal) palingu.
67. Refuse stone.
68. Gem sand.
69. Unassorted gem stones.
70. Gem sand from Pelawatta, Kalutara.
71. Cinnamon Garden sand.
72. Cabook gravel from Colombo.

GEOLOGY AND MINERALOGY.

(From *Ferguson's* "*Summary of Information regarding Ceylon.*")

The Geological formations met with in Ceylon are of the Palæozoic, Mezozoic and recent age. The greatest portion of the island consists of ancient sedimentary beds, doubtful deposited sea or lake, metamorphoses have obliterated all traces of fossil remains. Mountain ranges formed of primary and metamorphic rock. Principal rock, gneiss, with beds of laterite (locally named "cabook") and dolomite, according to some authorities,—described by others as crystalline marble or primary limestone. Plenty of iron, but no trace of coal. Manganese. Gold and platinum, but in such small quantities not apparently worth gathering. Molybdenum, Cobalt, Nickel, Tin, Copper and Arsenic also occur. Plumbago, the only mineral of commercial importance. Cretaceous beds of Jaffna of Mezozoic age. Nitre in caves. Salt forms naturally, and is also manufactured in sufficient quantity at Puttalam, Jaffna, and Hambantota, to supply the consumption of the Island. Calcareous Tufa met with at Bintenne deposited from warm springs. Hot springs at Trincomalee and other places, but no direct evidence of present volcanic action, and earthquakes seldom perceptible. Greenstone, however, underlies gneiss at Kadugannawa, and with vitrefactions is observed in fissures of rocks at Trincomalee. Spring of Sulphuretted Hydrogen similar to Harrowgate water occurs in Puttalam district. Large tracts of alluvium occur in the Nuwara Eliya and other districts. Process of slow upheaval believed to be in operation on western coast, with compensating disintegration of mountain ranges. Recent formation a breccia formed of particles disintegrated rock held together by calcareous and ferruginous matter near Negombo and along coast. Gems abundant especially about Ratnapura ("city of gems") but, with exception of blue sapphire and ruby, of slight value. A flawless sapphire is rare and good rubies are excessively scarce. Zircon or "Matara-diamond," and amethyst, common. Chrysoberyl (or "cat's-eye,") not uncommon, curious, and often prized. Moonstones (very beautiful form of "adularia") and "cinnamon stones," (brown garnets) common. Spinel and tourmaline very abundant. Many rocks and river beds sparkle with red garnets, beautiful but intrinsically valueless. Ceylon is celebrated for fine pearls.

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SILVER CASKET AND PRECIOUS STONES EXHIBITED AT THE MELBOURNE EXHIBITION BY MUDALIYAR P. B. GOMES.

(*From the "Ceylon Observer."*)

This highly finished Casket No. 15 in Supplementary List in Catalogue) made in Ceylon under the supervision of Mudaliyar Gomes is of pure silver, and can be unscrewed in pieces. It stands on four Ivory castors and measures 7½ × 5¾ × 4 inches. The carving is specially worthy of attention, as on the lid and sides of the casket are depicted a variety of the fruit-bearing trees and vegetable products of Ceylon. It also shews very well-executed figures of a Kandyan Monarch and his Adigars (Ministers). Among the products carved are the Jack tree, the Bread Fruit tree, Cinnamon, Coffee, Gamboge, wild Breadfruit, Coconut palm, Plantain, Kittul palm, Palmirah, Arecanut, Wild Date palm, Jambu tree or the Rose apple, Tobacco plant, Ash Gourd, Pumpkin, Long beans, Betel creeper, Pepper creeper, Cucumber, Carville, Sweet potato; besides these, an Elephant Kraal is depicted, and Native carvers at work.

The Silver Casket which is valued at 500 rupees (£50 sterling) contains a number of the precious stones of Ceylon cut and uncut, the list being as follows:—

No.	1	Ruby cut 1, uncut 6	value R120
„	2	Sapphire cut 1, uncut 2	40
„	3	Topaz cut 1, uncut 5	120
„	4	Cat's-eye cut 1, uncut 5	120
„	5	Starstone cut 4, uncut 1	20
„	6	Amethyst cut 3, uncut 1	15
„	7	Aquamarina cut 1, uncut 7	5
„	8	Tourmaline cut 2, uncut 4	5
„	9	Moonstone cut 3, uncut 9	25
„	10	Cinnamon stone cut 4, uncut 11 ...	5
„	11	White Sapphire cut 4, uncut 4 ...	5
„	12	Coins Ceylon, Gold 1	}
		„ Silver 9	} 30
		„ Copper 14	}
		„ Goldstone 1	}

or about 500 rupees' worth of gems and old coins.

PLUMBAGO.

(The only Mineral of Commercial Importance largely exported from Ceylon).

THE CEYLON TRADE IN PLUMBAGO.

(From the *Ceylon Directory and Handbook of Information for* 1881.)

Ceylon at the present time is the chief source of supply of plumbago or graphite. Most of the product of this island is carried to England for distribution or manufacture, but quantities are shipped direct to other countries, especially the United States. It has various uses. Much of it is used for making pencils, whence its name graphite. The graphite for pencils is obtained chiefly from Siberia.* The great consumption of the mineral, however, is for the manufacture of crucibles used in chemistry and metallurgy. It is practically infusible. There appears to be no meterial in nature fitted to compete with plumbago in the manufacture of crucibles for melting metals, and no source of supply with superior advantages to this island. Our plumbago (a form carbon) resists the action of fire better,

* Ceylon plumbago is used to mix with Cumberland graphite to make good pencils, the latter being too hard by itself.

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perhaps, than any othes substance except asbestos, and accordingly the demand for it has increased with the increased demand for the precious metals in the shape of coin, steel, &c.

The quinquennial Export of PLUMBAGO from Ceylon has been as follows:—

5 years ending	1841	average annual export		cwts.	(can't be given)
do ...	1846	do		,,	,,
do ...	1851	do	13,410	,,	
do ...	1856	do	13,950	,,	
do ...	1861	do	37,530	,,	
do ...	1866	do	57,295	,,	
do ...	1871	do	124,714	,,	
do ...	1876	do	137,474	,,	
3 do ending	1879	do	114,671	,,	

It will be observed that, notwithstanding a heavy export last year (162,000 cwt. in 1879), the average has latterly diminished but this is probably owing to the fact that the crucible-makers, both in England and the United States, made extra efforts to lay in stocks in view of the announcement that the Ceylon royalty was to be collected by the Customs instead of at the pit's mouth, the latter system being found to lead to the export of much of the mineral on which no royalty had been paid. Complaints having been made that the original royalty of R10 per ton bore very heavily on the lower qualities, the rate has now been reduced to R5 per ton. The maximum export of plumbago seems to have been in the twelve months ending 30th Sept. 1869, when nearly 200,000 cwts. were exported, and again, the commercial season ending with 30th Sept. 1880, is likely to shew a quantity very nearly equal, the shipments to 19th August aggregating 183,000 cwts.

The greater proportion by far of the plumbago which goes from Ceylon is used by two great crucible-making firms: one in England, the other in the United States of America*; and if only a certain number of crucibles are wanted by the melters of metals, it is clear that enlarged exports may result only in cheapening the raw product to the crucible manufacturers, in glutting the market, and in loss to traders and diggers. All the evidence within our reach seems to shew that from no other part of the world can better or cheaper supplies of this form of carbon be obtained than from the mines of Ceylon. We can supply all qualities for all purposes, from a crucible to a pencil, the exception, perhaps, being the so-called "black lead," requisite for the finest kinds of drawing pencils. Here we yield the palm to Cumberland; but it suppers Ceylon plumbago is used to mix with the fine Cumberland description.

It is impossible to get the exact number of plumbago mines and pits in Ceylon, but it is usually reckoned at about 400, besides 230 gem and 30 iron quarries.

PLUMBAGO MINE AT KEGALLA.—Mr. C. Matthew's mine in this neighbourhood, constructed under the direction of a Cumberland miner, is said to be unique so far as Ceylon is concerned. A regular shaft has been sunk to a depth far below that ever attempted by the Sinhalese. A steam engine, pumps and other apparatus have been erected, and altogether capital and enterprise freely expended. Many years ago, two Cumberland miners, friends of Mr. Robert. Dawson, went in for regular mining, but did not succeed. They afterwards went to Bombay and made and lost a great fortune.

In lieu of a royalty formerly levied at the pit's mouth, the Government now collect a small revenue from this plumbago in the shape of a Customs duty of R5 per ton. With this exception and a royalty of R200 on each

* This American firm, the Dixon Crucible Company, Jersey City, New York, has for years back competed with the Battersea Crucible Company of London for our Plumbago, and the result is that the export has risen.

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elephant caught in the Government forests and sent abroad, there are no export duties levied in Ceylon. The export of plumbago, which gives employment to a considerable number of the natives of Ceylon, has been for a series of years back:—

		Cwt.			Cwt.
1850	...	23,823	1875	...	149,938
1860	...	5,660	1878	...	84,635
1865	...	40,144	1879	...	162,495
1870	...	85,249			

Last year's export was valued at £160,000.

THE CEYLON PLUMBAGO INDUSTRY.

From the *Ceylon Observer*, 12th August 1880.)

A visit we paid the other morning to the Plumbago Store of Mr. W. A. Fernando, at No. 1, Brownrigg Street, Cinnamon Gardens, has given us a new and enlarged view of the ramifications of the Plumbago Industry of Ceylon. We were, of course, familiar with the rise and progress of our export trade in this the only mineral of any importance of which Ceylon can boast. We knew from the official returns that, while thirty years ago (1851) the total export only equalled 13,410 cwt., last year the quantity shipped had mounted up to no less than 162,000 cwt. But although it was quite evident that the digging and mining which brought so large a quantity of plumbago to light, as well as the carting, preparation, and picking, must give employment to a great number of people, we had no idea before the inspection of Fernando's store of the very considerable influence which the industry now has on the welfare of many thousands of the population in the Western, the North-western and Southern Provinces. The favourite mining districts are at present in the neighbourhood of Kurunegala, Awisawella, Ratnapura and Kalutara, and in the Pasdum Korale. Mr. Fernando, a most intelligent enterprising Christian Sinhalese of Moratuwa whose father and family have for many years been connected with "plumbago," was unable to tell us that the seekers after plumbago were guided by any better indication than the appearance of the surface soil, or of pieces of the mineral cropping up through fissures in the rock. Here is just the case where a Government Geologist might afford valuable aid in developing an important industry. Mr. A. C. Dixon, if employed by Government during the Academy vacations, might be able to point with much confidence to undeveloped Crown lands likely to prove of great value for their beds of plumbago, and his advice to private proprietors might also save much time and money in trial pits, surface digging, and general exploration. Plumbago mines have been sunk in Ceylon several hundred feet in depth, and some are worked with all the appliances of an English mine, but, as a rule, the plumbago is found near the surface. It is difficult to say how many men are engaged in digging plumbago, but taking half-a ton for each man per month in a favourable field as a high average, and making allowance for the wet seasons, holidays &c., we may feel sure that no less than from 4,000 to 5,000 men were required to provide the quantity shipped last year. The carting to Colombo must have given employment to a good many others, perhaps more or less to 500 carters, carts and pair of bullocks. But it is the elaborate preparation now observed in the Colombo stores which has taken us by surprise. Plumbago is now picked and sized, we may say, as carefully as coffee. The various processes are seen to perfection at Mr. W. A. Fernando's store. He gives employment to from 120 to 150 men and women,* paying from 50 to 75 cents per

* Sinhalese women have only lately been induced to work as plumbago pickers; their manual dexterity give them an advantage over men, but Mr. Fernando had trouble in overcoming a strange prejudice they had to plumbago as poison or worse for them to touch with their finger; Now they like the work and come to it readily,

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diem to the former, and 25 to 30 cents to the women. His stores and picking-houses are all cadjan-roof (that is, roofed with coconut leaves), for the very good, but to us novel and strange, reason that the tiles would inevitably fall off any roof under which plumbago was stored or prepared. The dust blown about makes everything so polished and slippery, even the roof rafters and reepers, that tiles constantly slip off, and therefore the only safety lies in cadjans! The process first is to wash the plumbago in large baskets, the smaller pieces and dust being afterwards spread on an asphalte barbacue to dry. By this means the quality is easily discovered by the practised eyes of the pickers, who separate (in much the same way as coffee) pieces affected by iron ore, pyrites, quartz, or other foreign material, a small piece of which passing into a consignment to the Battersea Crucible Works might ruin the whole lot. Some of the pickers are furnished with iron hammers to break up suspicious-looking pieces of the plumbago, and others again are employed in brushing the dust off good lumps, and polishing the same with coconut husks. There are punched sheet-iron sizers with holes of different dimensions (Nos. 1 to 4), and accordingly large lump, small pieces, chips and dust plumbago are now a days carefully separated. It takes about 100 expert men and women to prepare two or three tons in a day, consequently this branch of trade must give employment to several thousands of people for the greater part of the year. The cask-making and packing afford further occupation, each barrel holding about 5 cwts., so that some 35,000 casks all made of *Hora* staves (generally deemed a useless timber) were required for last year's shipments. The plumbago is also carried from the mines to Colombo in barrels, which, however, are sent back in shooks and so used repeatedly. Three men are supposed to make 8 or 10 barrels a day. Altogether therefore it will be seen that the Ceylon plumbago industry is a very important one to our Sinhalese neighbours.

Mr. W. A. Fernando, whose model store is well worthy of inspection, sells to the European mercantile houses as much as from 1,200 to 1,800 tons per annum. In olden days he used to ship on his own account, and he has received prices as high as £32 and £48 per ton for lump plumbago, which is now only worth £15. His Brownrigg Street Store should be visited during the busy season, by all who wish to get some idea of the importance of the PLUMBAGO INDUSTRY OF CEYLON.

Appended are extracts from the Annual Administration Reports of the District Revenue Officers of the Ceylon Government containing references to plumbago and other minerals:—

(From the Report on the Sabaragamuwa District for 1873.)

Plumbago, which sold at 200 rupees per ton, now realizes 90 rupees; the working expenses have considerably increased by the enhanced value of labour, and the difficulty of procuring suitable machinery in substitution thereof. One of the native Companies, I understand, indented for a force pump, but when it arrived, the hose was discovered to be one-fourth the size required by the machinery: so after pumping unsuccessfully for a couple of days, they gave up in despair and took to the hand-bucket system of raising water more adapted to their taste.

(From the Report on the Sabaragamuwa District for 1874.)

Very little mining operations have been carried on during the year on account of the scarcity of labour and low prices. Plumbago is at present unsaleable; iron cannot be manufactured for its marketable value; and even gems are not as plentiful as formerly. Of the latter, only three were of any great value, and realized from 3,500 rupees to 4,000 rupees each. It is most remarkable that gems command a higher price here than at Colombo or Galle.

On the discovery of a good "stone," correspondents advertise it in the local papers, and merchants from all parts of the country flock in and bid

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each other up to a ridiculous figure. There are instances where a sapphire which sold here for 2,500 rupees, changed hands subsequently at Colombo for 1,500 rupees; and in the case of the last find (a ruby, the size of a walnut) the owner refused 5,000 rupees here, to discover, on his arrival at Colombo, that it was flawed and worthless.

(*From the Report on the Hambantota District for* 1868.)

A new branch of industry—not in the interest of agriculture, indeed, but of mining—has, I am glad to be able to report, within the last few weeks, been introduced: one from which much good will result, both as opening out a fresh and remunerative field of labour, and inducing a flow of capital into the district. I allude to the finding of plumbago, of excellent quality, at Warapitiya in Giruwa Pattu near the Kirama Reservoir Traces of the mineral had previously been found in other parts of the Pattu: and I had long been of opinion that ample quantities would in time be brought to light. The value of the discovery is not to be overrated, as the demand in England for the mineral, which is for the first importance in the arts, is immense and constant. The attention of merchants interested in the export of plumbago, is cordially invited to the discoveries recently made.* It may be worth while to note here also, that what is believed to be magnesian lime stone occurs close to the main road to Badulla about sixteen miles north of Hambantota.

CEYLON KAOLIN FOR POTTERY.

(From the *Ceylon Observer*, July 28, 1879.)

We owe to Sir William Gregory (whose continued interest in Ceylon is being displayed in so many ways) a trial which has been given at "Minton's China Works" to a sample of our finest kaolin, better known by the native name kirimeti. We regret to say that the result has not been so favourable as was generally anticipated. In a Chinese history of the Ming dynasty, A.D. 1368-1643, "pottery-stone" is enumerated among the imports into China from Ceylon, and for a generation back we have been accustomed to regard our kaolin as equal to the manufacture of fine ware—Emerson Tennent declaring its colour to be so clear as to suit for the manufacture of porcelain—the difficulty and cost of carriage alone rendering it unavailable for the European manufacturer. But the report of such competent authorities as "Minton's" to Messrs. Goode, London, runs as follows:—

"In your package to-day we send a breakfast cup and saucer made from the sample clays sent to you by the late Governor of Ceylon. We also enclose three sample 'bats' made from the same clay, the one marked No. 151 having been simply washed and then fired. From the sample now sent, you will see it is too full of dirt of our use. We have labelled the underside of the saucer."

The Colonial Secretary, Mr. Douglas, we believe, brought out the cup and saucer referred to, from Sir william Gregory, for deposit in the Colombo Museum. They are not regarded as a success by our late Governor, and, as there can be no doubt of the care exercised in selecting his sample of kaolin, there is not much encouragement to try again with further samples through "Minton's" or other home manufacturers. According to an analysis made in 1847, the kaolin of Ceylon consists of

Pure kaolin	70·0
Silica	26·0
Molybdena and iron oxide	4 0
	100·0

* A sample of the Plumbago has been submitted to the Colombo Chamber of Commerçe, who pronounce the quality to be fairly good and likely to command about £12 or £14 a ton in Ceylon. The Chamber, I am happy to observe, exhibit a warm interest in the matter, which is one of great consequence to the district. It is probable the hill Ranmalakanda will be found rich in Plumbago and in Iron Ore.

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THE CUP AND SAUCER made from Ceylon kaolin at Sir Wm. Gregory's instance will be on view henceforward at the Museum. They are pure white and well-finished, although bearing traces of impurity. The saucer has the following inscription in red script on the back:—"Made with China clay, sent by the Governor of Ceylon, by Minton's, Stoke upon Trent, England; March 11th 1879." Three accompanying specimens shew Ceylon China clay fully, half, and not fired.

"GEMS IN CEYLON."

A SAPPHIRE FOUND IN SABARAGAMUWA WORTH FROM R130,000 TO R140,000!

(From the "*Ceylon Observer*," June 6, 1881.)

In a letter received in Colombo today from Mr. C. M. Hassena Marikar, the well-known landed proprietor and gem-digger of Rakwana, he states that he has found a sapphire of the finest quality, weighing about seven rupees (over 52 dwts.) and which he therefore values at from R130,000 to R140,000! Allowing for the natural exaggeration of the fortunate owner, it is believed in Colombo that Mr. Hassena Marikar is safe to make £10,000 out of his find. It is surely time that European capitalists turned their attention to the Gem-digging industry and that the Government made the most of their property in this connection. We have been collecting for our pamphlet all the information available in every possible quarter about Ceylon Gems as well as Ceylon Gold, and we find much reason for believing that the Sabaragamuwa and adjacent districts—at least so far as sapphires, rubies, cat's-eyes and their inferior congeners are concerned—comprise one of the richest gem-yielding regions in the world. Sindbad's valley must be in the neighbourhood of "Ratnapura," "the City of Gems"! Ceylon indeed seems to be almost the only reliable source of supply now for a good many precious stones. It is significant of what is thought of the island in this respect, to find so good a judge and so large a dealer as Mr. Streeter advertising in all the bestknown London journals, simply as follows:—

MR. EDWIN STREETER,

Dealer in Precious Stones,

of 18 New Bond Street

and

COLOMBO, CEYLON.

We believe there is a project on foot for the promotion of a "Ceylon Gem-digging Company, Limited," and that the prospectus is now in the hands of influential "City" men in London. Should such a Company be established, we may look for an entire revolution in the system of gemming at present in vogue in the island. Machinery will become the rule instead of the exception. Not only the pumping but much of the excavating work can surely be done by steam or water power applied to suitable machines. The Australian papers continue to bring us the most satisfactory accounts of the performances of Sir Thomas Elder's steam-coop, a machine which ought to be turned to account in more directions than one in this Colony.

PROBABLE INCREASED DEMAND FOR CEYLON GEMS.—We read in a home paper, that a novelty in the use of jewels has been inaugurated this winter by the Princess of Wales, who has been the first to wear an earring of sapphire set with diamonds in one ear and in the other a ruby likewise surrounded with

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brilliants. The fashion having been set, will no doubt be largely followed:—Sapphires and rubies must be in request and there is no country we believe at this moment so well able to supply these gems as is Ceylon.

TEMPLE JEWELS.

A few of the jewels belonging to some of the Dewales (Temples) at Kandy given as specimens of value, are as follows:—

One small relic case set with precious stones, gold... ...	£2,000
One gold betel stand set with rubies called Dalomarebattoo...	437
One gold book, written in Sinhalese letters containing 24 leaves and set with blue sapphires and rubies	562
One gold fan set with precious stones...	48
One small relic case set with stones	1,000
One do Perahera karandu	300

THE ROCKS AND MINERALS OF CEYLON.

By A. C. Dixon, B. Sc., (Honors) London.

(From the *Ceylon Branch R. A. S. Journal*, 1880.)

The science of geology divides itself naturally into three departments:—

(*a.*)—The study of rocks, or *Petrology.*

(*b.*)—The study of the minerals of which rocks are composed, or *Mineralogy.*

(*c.*)—The study of the remains of animal and vegetable life contained in the rocks, or *Palaeontology.*

To the one who makes this last division his object of research there is but a poor field before him in Ceylon, save in the north of the island; but for the one interested in rocks and their component minerals, there is plenty of scope for research. Geological time is divisible into three great periods separated by great breaks in time, but this cannot really be the case, for, as nations have sprung up and passed away gradually, so also have formations. These have always been and will be continuous. Although in England we have great gaps separating one formation from another, yet we have beds of passage in several parts of the world, which bridge over these gaps and so form a connecting link.

The three great epochs of geological time are the *Palaeozoic* or old life period, the *Mesozoic* or middle life, and the *Cainozoic* or recent life.

Each of these has numerous divisions. The bulk of this island consists of ancient sedimentary beds; whether deposited in sea or lake, we are unable to say, for the metamorphism which these beds have undergone due to internal heat, pressure, time and various other causes) has obliterated all traces of fossil remains. Over this *gneiss* around Colombo and in many other parts of the island, we have the well-known *laterite* or cabook, so largely used for building purposes. This formation has given rise to much discussion. It is essentially a derivative from the gneiss; and, beyond doubt, in many cases *in situ*, as is evident in several cuttings which have been made, a notable one, which I visited some time ago, occurring in a cutting made while searching for plumbago between Polgahawela and Ambepussa. In many ravines in the hill districts of the island, especially in Dimbula and Dikoya, we have an iron conglomerate at present in course of formation, composed of the debris of surrounding rocks, firmly held together by ferruginous matter, which rock when subjected to decay, would furnish a formation exactly akin to our laterite. I have dealt with this subject (Laterite) at greater length in a paper to the Royal Academy of Sciences, Sweden.

In the north of the island we have a formation of the Mesozoic, or secondary period, viz., the *Cretaceous.* These beds are no doubt contemporaneous with the Pondicherry beds, which have yielded numerous fossils, by which their age has been determined. I have no doubt that many fossils might be gathered in our

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Northern Province by those interested in Palæontology. Once, it is recorded, this Society possessed in its Museum a fossil phalange from this district, but it has been lost.

Of *recent* formations, we have on the sea coast between Negombo and Mount Lavinia, and for some distance beyond these places, a recent breccia formed of particles of disintegrated rock, more or less compact. At Talpitiya it occurs at a considerable distance from shore (300 yards), and at a depth of twenty-five feet. Numerous minute shells and fragments of shells occur in this. At Pamunugama, on the way to Negombo, the sandstone varies much. In some cases it is black-banded, with particles of magnetic iron; in others the particles of iron are evenly distributed throughout the mass. The nature of the cement which binds these particles together is carbonate of lime.

Calcareous Tufa, still in the course of formation, is a deposit from the hot-water springs of Bintenna, the water of which is highly charged with carbonate of lime, which is deposited as the water cools. It is known as Pennagal by the Sinhalese, and is burnt and used by them along with their betel.

The foregoing formations are indicated on the accompanying rough geological sketch map.

I will now consider more particularly the *gneiss*, which is our most extensive formation. It varies much in texture, colour, composition, hardness, &c.

Its composition is the same as granite, only the degree of metamorphism has not been so great as to entitle it fully to that name.

It is composed of quartz—felspar (both orthoclase and oligoclase)—muscovite and biotite (micas), hornblende, chlorite, and numerous accidental minerals in varying proportions.

In some localities we find a rock composed of only one of these, as in the case of hornblende rock; at other times only felspar, but generally the foregoing components are mingled together in varying proportions, giving a large number of different kinds of rock.

Orthoclase forms the main mass. The two felspars are easily distinguished on a weathered surface. The orthoclase is glassy and somewhat pearly in lustre, and has a translucent aspect, while the oligoclase is dull and opaque.

In the gneiss we meet with various *beds* as limestones, dolomite, magnetite, quartz, hornblende, tremolite, mica, epidote. Some of these occur, also, as *veins* in the gneiss.

In the veins we have the minerals, actinolite, tremolite, jade, talc, muscovite, biotite, epidote, schoral, and many others of minor importance.

Actinolite is found in the Kotagala district. Good specimens of crystalline talc are obtainable from Mahara quarry and neighbourhood.

The gneiss in some cases almost passes into syenite. Where the felspar is flesh-coloured this rock much resembles Peterhead granite. Porphyritic gneiss occurs on the hill ranges not far from Heneratgoda.

At Balangoda we meet with a crude jasper, and not far from the same locality a large mass of graphic granite in which the quartz is distributed in bands, and when viewed endwise much resembles an inscription.

When subject to action of water the felspar of the gneiss soon decomposes, and so a large number of decomposed forms are very abundant. As the island is gradually uprising it is evident that the less elevated portions have been under the influence of water for a longer period, and, consequently, the cuttings through such are less difficult than similar ones in the more elevated portions. Another peculiarity of the gneiss is the occurrence of garnets in large quantity.

Dolomite beds. As far as I have been able to trace during the time at my disposal, I find that these beds run through the gneiss in a somewhat parallel direction, striking generally N.W. by N. to N., and having various angles of dip from 10° to 40°.

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I have indicated their position on the map. The first is one which outcrops a few miles this side of Balangoda, and runs N.N.W., occurring again at Hanuwala.

The second runs through Dolosbage and Maskeliya; probably the bed occurring at Bilhul-oya is continuous with this.

The third outcrops under the Great Western on the Great Western estate, and is continuous to the N.N.W. with the Wattegoda and Medakumbura dolomites, and probably also with the beds at Gampola and Kurunegala. A subsidiary bed—or it may be an outlier of this—occurs near the Pussellawa rest-house.

The fourth bed outcrops largely at Wilson's Bungalow, Glen Devon, Dumbara and Matale.

The fifth occurs in the Badulla district. As in the gneiss we have a great many varieties so also in the dolomites. They all contain carbonate of magnesia, which varies from 1 to over 40 per cent.

These limestones are very valuable for estate purposes as well as for building stone and building lime.

In colour they vary much, dependent on the numerous accidental minerals that occur along with them. Thus the specimens from Wilson's Bungalow are very dark: they contain pyrites, phlogopite, chlorite, epidote, &c.

A dolomite occurring at Wariapola on the Matale railway contains a large amount of blue spinel. Some of the crystals of these dolomites have large facets, others small and of a granular texture. Many contain white translucent siliceous grains not easily distinguished.

A beautiful example of limestone of a somewhat peculiar tinge, due to the metal chromium, occurs beyond Balangoda, and often contains fine specimens of crystalline biotite—a magnesian mica. This limestone shews a very peculiar and characteristic weathered surface.

Plumbago is found in several localities as at Kurunegala, Kegalla and Nambapana. In the Balangoda district we have the metal molybdenum, so useful in chemical researches; and black oxide of manganese from Ratnapura and neighbourhood.

Various forms of iron occur in the gneiss, thus iron pyrites. Magnetite, a very highly magnetic iron ore, is found in the Pussellawa district with a peculiar cleavage and fracture. Botryoidal limonite, an oxide of iron found under the cinnamon sand near Negombo. Haematite occurs in other parts of the island.

Traces of gold and platinum I have met with in the Ramboda and Kurunegala districts. Extensive beds of quartz occur in the Pussellawa district, which is not much unlike the reef-bearing quartz of the Wynaad.

In some localities the felspar of the gneiss is much decomposed and forms large masses of kaolin (*Kirimeti* of the Sinhalese), occurring largely in the Nuwara Eliya and Maturata districts. This is capable of being made into a very fair porcelain.

Large masses of *alluvium* occur on the Nuwara Eliya plain, and shew us the remains of the surrounding hills, deposited no doubt in a former lake.

In the alluvium of many of our river basins, notably at Ratnapura, we have numerous minerals—the *gems* for which this town is so noted. I will briefly notice some which I have gathered there.

First, I will deal with the corundum or sapphire family, which crystallizes in the hexagonal system. If a stone of this family lacks transparency and is dull, we call it corundum: it is useful as a powder (emery) for cutting other stones. If of a rich blue colour it is called sapphire; of white, white sapphire; red, ruby: purple, the oriental amethyst: of yellow, the oriental topaz; of green, the oriental emerald.

Some of the sapphires are partly blue and partly white. The Sinhalese can, by heating these in a certain manner, distribute the colour evenly, or by greater heat can discharge the colour and so pass them off as white sapphires. The specific gravity of such, however, is diminished. Many other

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stones, as the zircon, are treated in a similar manner. A good test for a sapphire is, that in a dark room or closet, with the light of a match or candle, it should appear equally rich in colour as in ordinary light. Sapphires are lamellar in structure, and so on being cut of a convex form, we have the appearance of a six-rayed star.

Spinel. Another mineral abundant in Ceylon crystallizes in the cubic system generally in octohedrons or rhombic dodecahedrons. In colour this mineral varies much; red, however, is very common, and it is sometimes sold as ruby. The specific gravity of spinel is about 3·5, while ruby is 4 and garnet 3·8.

Green spinel is occasionally met wtth at Ratnapura and in the Kandy district.

Garnet, of various kinds, is found in Ceylon both in the metamorphic rock as well as in the alluvium. This usually of a red colour, and crystallizes in the cubic system.

Cinnamon stone (essonite) is a kind of garnet found largely at Matara.

Zircon crystallizes in the tetragonal system, and is found of many colours. Several varieties are disregarded by the Sinhalese; others are used, notably the white zircon, otherwise known as the Matara diamond. Quartz is often cut and sold as Matara diamond.

Chrysoberyl belongs to the rhombic system of crystals, and when cut *en cabochon* furnishes the true cat's-eye.

Tourmaline (S. Toramalli) crystallize in the hexagonal system, generally in the prisms with dissimilar ends. In colour it varies much; thus, we have black, green, brown, yellow, &c.

The peridot of Ceylon is yellow tourmaline. The natural crystals shew a fine striation on their long sides.

Moonstone or adularia is a felspar with a pearly appearance. Quartz and selenite are often sold under the same name.

Rock crystal crystallizing in the same system as the sapphire, and is very abundant at Ratnapura, Balangoda and many other localities.

Specimens Exhibited, Illustrating the Paper Read.

1. Gneiss—with large flesh-coloured crystal of felspar. Balangoda.
2. Gneiss—with molybdenium from Petiagalla.
3. Gneiss—with iron garnets. Kotagalla.
4. Gneiss—with ordinary garnets. Madola. Sabaragamuwa.
5. Gneiss—with quartz crystal, epidote, &c. Mahara.
6. Epidote and black mica. Ythanside, Dimbula.
7. Gneiss form under gem-pits. Ratnapura.
8. Gneiss with epidote. Ramboda.
9. Hornblende pebble. Madola.
10. Graphic granite. Balangoda.
11. Crude jasper. Balangoda.
12. Gneiss—decomposed. Abbotsford, Dimbula.
13. Gneiss—decomposed, with epidote, chlorite, &c. Balangoda.
14. Quartz—with plumbago. Diatura, Kurunegala.
15. Hornblende (crystalline). Matale Railway.
16. Mica—pebble. Dimbula.
17. Mica—from cabook. Welikada, Colombo.
18. Mica—much decomposed. Ratnapura.
19. Iron conglomerate. From ravines, Dimbula.
20. Iron ore. Dimbula.
21. Decomposed gneiss from a slip on Matale Railway, shewing the nature of "slickensides."
22. Magnetite. Harmony estate, Pussellawa.
23. Cabook. Colombo.
24. Limonite (botryoidal). Negombo.

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25. Dolomite, with large crystal of mica. Nonpareil, Bilhuloya.
26. Dolomite, with epidote, &c. Aluwihara. Matale.
27. Dolomite, with pyrites and other crystals. Kurunegala.
28. Dolomite, with garnets, epidote, mica. Wilson's Bungalow.
29. Dolomite, with blue spinel iron, mica. Wariapola, Matale.
30. Dolomite, very compact. Wilson's Bungalow.
31. Dolomite, with black weathered surface. Wattegoda, Dimbula.
32. Dolomite, large yellow free crystals. Kurunegala.
33. Dolomite, with curious weathered surface and containing mica, iron plumbago, quartz, &c. Balangoda.
34. Dolomite, very impure, abounding in quartz and shewing a peculiar weathering. Great Western, Dimbula.
35. Kaolin, red, impure. Maturata.
36. Kaolin, white, very pure. Nuwara Eliya.
37. Manganese (black oxide). Ratnapura.
38. Iron, pyrites. Mahara.
39. Felspar, decomposing. Nuwara Eliya.
40. Labradorite. Mahara Quarry.
41. Rock crystal, smoky. Nuwara Eliya.
42. Rock crystal, white pebble. Ratnapura.
43. Sandstone with numerous shells. Talpitiya.
44. Sandstone with magnetic iron in bands. Pamunugama.
45. Sandstone with iron evenly distributed. Pamunugama.
46. Sandstone, very dark. Pamunugama.
47. Limestone from Jaffna (Cretaceous).
48. Quartz (vein). Balangoda.
49. Gneiss with silvery mica, green, blue, and red sapphire. Badulla.
50. Talc, crystalline. Mahara Quarry.
51. Gneiss with garnet. Top of Adam's Peak.
52. Calcareous Tufa. Bintenna.
53. Clay from gem pits.
54. Calcite. Matale.
55. Felspar, crystal. Ythanside.
56. Sapphire crystals. Ratnapura.
57. Sapphire (star).
58. Sapphire, white.
59. Sapphire, yellow.
60. Sapphire, parti-coloured.
61. Corundum.
62. Ruby.
63. Amethyst, crystal.
64. Amethyst, cut.
65. Spinel. Ratnapura.
66. Spinel. Wattegama.
67. Zircon.
68. Zircon (cut). Matara diamond.
69. Chrysoberyl.
70. Chrysoberyl (cat's eye).
71. Alexandrite.
72. Garnets.
73. Cinnamon stone.
74. Cinnamon stone (cut).
75. Tourmaline, crystal.
76. Peridot of Ceylon.
77. Moonstone.
78. Moonstone, cut.
79. Quartz crystals.

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80. Actinolite.
81. Iron pyrites. Gem-pits.
82. Steatite. Nuwara Eliya.
83. Zircon (white). Ythanside, Dimbula.
84. Gems. Pelawatta.
85. Gem sand.
86. Black crystal. Deduru-oya, Kurunegala.

INDIAN GOLD MINING COMPANIES.

Enterprise in connection with the gold fields in the Wynaad and Mysore districts of Southern India as now acquired so considerable an extension, that the subjoined particulars, compiled and supplied by a correspondent of the *Financier*, will be found interesting. A complete view is here given of the extent to which British capital has become engaged in this direction. The figures are all carefully taken from authentic sources, and the most recent statements emanating from the several companies, and, when in doubt, they have been verified by direct inquiries at the offices:—

INDIAN GOLD MINING COMPANIES IN THE WYNAAD DISTRICT OF MADRAS. ALL IN SHARES OF £1 EACH.

Date of Issue.	NAME.	Capital.	Price in Cash and Shares.	Acreage of Whole Property	Acreage of Mining Rights.	Acreage of Surface Rights.
1879 Dec. 5	South Indian (a)	100,000	50,000 & 7,500	1200	1200	1200
1880 Jan. 27	South-East Wynaad Estates (b) ...	100,000	60,000	2536	736	2536
Feb. 2	Indian Glenrock (c)	100,000 & 40,000	50,000 & 35,000	3150	3150	3150
April 19	Indian Grange (d)	100,000	47,000	300	300	300
April 13	Balcarris (e)	180,000	100,000	1198	1198	1198
June 25	Devala Moyar (f)	200,000	132,000	2055	1029	2055
Aug. 14	Devala Provident	75,000	30,000	120	120	120
Aug. 21	Indian Mammoth	150,000	70,000	1500	1500	1500
Sept. 18	Wynaad Perseverance (g)	80,000	50,000	600	15	600

(a) Has just sold about 600 acres (Attikunno Estate) for 46,000*l.* (and 4,000*l.* for surface rights) to the Indian Trevelyan. Machinery is now on spot and in course of erection.

(b) Including Needlerock Estate. Has option of extending mining rights any time during the next four years.

(c) Machinery on spot and in course of erection.

(d) Withdrawn.

(e) Withdrawn.

(f) Since sold 50 acres to the Rhodes Reef Company for 130,000*l.*

(g) Same Board of Directors as South-East Wynaad Company. Can have increased acreage of mining rights any time before 1886.

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Date of issue.	NAME.	Capital.	Price in Cash and Shares.	Average of Whole Property	Average of Mining Rights.	Average of Surface Rights.
Oct. 15	Indian Phœnix...	150,000	85,000	800	805	800
Oct. 15	Wala Wynaad Indian	75,000	35,000	500	330	339
Nov. 4	Devala Central (h)	120,000	70,000	986	25	9 98
Nov. 11	Rhodes Reef (i)	190,000	130,000	50	50	50
Nov. 18	South-East Wynaad	100,000	65,000	677	677	677
1881						
Jan. 3	Needlerock Estate (k)	125,000	85,000	250	250	250
Jan. 3	Charambadi (Wynaad) District ...	100,000 Issued 50,000	32,000	200	200	200
Feb. 4	Indian Trevelyan (l)...	150,000	96,000 & 4,000	930	930	930
Feb. 10	Tambracherry Estate and Wynaad ...	160,000	120,000	6184	6000	6000
Mar. 19	Carta Para	50,000	½ net profit	300	300	300
Mar. 21	Dingly Dell Estates (m)	100,000 power to inc.	70,000	600	415	415
Mar. 21	Simons' Reef (m)	120,000	—	—	—	—

INDIAN GOLD MINING COMPANIES IN THE KOLAR DISTRICT (MYSORE TERRITORY), MADRAS. ALL IN SHARES OF £1 EACH.

Date of Issue.	NAME.	Capital.	Price in Cash and Shares.	Acreage.	Full Mining Rights for
1880					
July 6	Mysore	135,000	55,000	750	30 years
Oct. 15	Colar	150,000 Issued 75,000	40,000	320	do.
Oct. 24	Ooregum	125,000 Power to inc.	75,000	256	do.
Nov. 8	Nundydroog	100,000	50,000	494	do.
Nov. 19	Mysore Reefs	120,000	75,000	320	do.
Dec. 28	Gt. South. Mysore... ...	75,000	45,000	150	do.
1881					
Jan. 27	Madras	135,000	85,000	320	do.
Mar. 24	Noth Ooregum	120,000	75,000	320	do.

(h) Indian Gold Mines Company (of Glasgow) to crush this company's ore. Can increase acreage of mining rights at option before 1886.

(i) Same Board of Directors as Devala-Moyar.

(k) Withdrawn Feb. 22.

(l) Bought about 600 acres of the South Indian Company.

(m) Not yet issued to the public.

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NOTE.—Besides the above companies, the following were registered in 1880:—The Indian Goldfield Co-operative Association, capital 1,200,000*l.*, in 1,000 shares of 120*l.* each, and 90,000 shares of 12*l.*; Nilghery and South Indian Gold Mining Syndicate, capital, 7,500*l.*; but I have not been able to obtain any further particulars of them. A Company called the Gold Company of Southern India is also very early in the field. Its prospectus stated that it started "unfettered with any contracts," but proposed to use the 100,000*l.* it asked for to find and purchase a suitable estate. In the second prospectus the company announced its intention of buying the Lakadio and Matudella estates for 45,000*l.* Shortly after this the company was voluntarily wound up, and the South-East Wynaad Gold Mining Company now owns these two properties, for which it paid 65,000*l.* This makes a total of thirty-two South Indian Gold Mining Companies registered in London since December 1st, 1879—say sixteen months.

Taking out of the calculation all Companies which are known to have been withdrawn, or which have not yet been publicly offered, the figures come out thus:—Sixteen Wynaad Mines: capital 1,890,000*l.*, of which the vendors take 1,121,500*l.* (and half profits on Carta Para), leaving a total working capital of 768,500*l.* The total acreage is 22,388 acres, so that the price paid to the vendors averages 50*l.* 1s. per acre. Seven Mysore mines; capital 750,000*l.* of which the vendors take 415,000*l.*, leaving a total working capital of 335,000*l.* The total acreage is 2,930 acres, so that the price paid to the vendors averages 141*l.* 12*s.* 9*d.*

But the average price paid per acre is of course no guide to the value of a mine, although many seem inclined to lay much stress upon it; and the only reason for setting out the above calculation is to show why separate tables have been made for the two districts in which the mines are located. People are too apt to look upon these districts as merely different parts of the same gold field, whereas they are 240 miles apart, and must be developed under different conditions. The relative price paid per acre in each gold field is cited to bring this difference home to all interested.—*Overland Mail.*

INDIAN GOLD FIELDS.

(*From Mr. Brough Smyth's Official Report.*)

Features of the country in the southern parts of the Nambulukod and Munanad Amshoms.—The chief physical feature in that portion of South-East Wynaad, which has been examined, is the dividing range extending from Hadiahbetta on the south-west to Marpanmadi North Peak on the north-east. This range separates the waters of the Pandi river from those flowing to an affluent of the Noogoo river, and for a portion of its length forms the boundary between the Nambulukod and Munanad Amshoms.

The ridge from the edge of the Carcoor ghât to a rocky eminence near Needle Rock is covered with thick jungle. The lower slopes have been cleared and are now planted with coffee.

The culminating points of this part of the range are Hadiahbetta about 4,000 feet, Needle Rock 4,600 feet, and Marpanmadi North Peak 4,650 feet.* The lowest "saddle" in that part of the range near Deväla is approximately 300 feet below the general level of the summit.

On the east and west side of the range there are lower ranges—the boundaries of distinct small drainage areas—but they are not continuous, well-defined even ridges; they consist of rounded hills having smooth contours and connected with each other by low saddles, thus reminding one rather of those areas in which granitoid rocks prevail than of those in which, in other auriferous regions, the even symmetrical, almost rectangular, ranges of the lower Silurian rocks offer so many facilities for sketching the country with accuracy and comprehending rapidly its systems of drainage.

* The figures here given are approximations only.

At the foot of the hills and at levels varying but slightly, there are numerous swamps and flats (usually intersected by small water-courses) which are in part cultivated by natives.

The summits of the hills forming the subordinate ranges are from 100 feet to 400 feet and more above the level of these swampy flats. The swamps are natural water-reservoirs, the water being stored in the strata overlying the bed-rock. They are generally well grassed but some are mere bogs, or, where well sheltered, densely covered with screw-pines, or, where partially drained, supporting a thick growth of thorny plants and scrub.

The streams having their sources in the hills after the burst of the south-west monsoon and generally during the months of June, July, August, and September, are torrents rushing over rocky beds, which on reaching the low flat lands unite to form perennial streams. In October there are often heavy showers sufficient to swell the brooks; but in November, December, January and February many of the sources are almost dried up, the waters of the main streams decrease in volume; and in March, April and May, the hot season, when dry harsh winds are not infrequent, and when the grass in the earlier part of the season is on fire on the hills, the tributaries of all the rivers exhibit a marked difference of character.

The smaller tributaries, the sources of the streams, have cut rather deep channels in the sides of the main range and the hills! the descent is rapid and the direction of each nearly straight; it is only when they unite and flow through the low level lands that they have a tortuous course.

The soils on the slopes are, where protected, moderately good and deep. In colour they are light reddish brown, brown, dark brown and nearly black, the latter having a fair proportion of decomposing vegetable matter. Elsewhere they are very thin resting on hard rock or on strong tenacious clays derived from the decomposition of the country rock *in situ*. These clays are but little affected by the heavy rains: the surface of them becomes glazed, and running water does not cut into them as it would do if they were arenaceous. Where cuttings are made, the clays stand for a height of fifteen feet or more perpendicularly, and, in some parts, even for a vertical height of fifty feet, the rains scarcely affecting the surfaces at all.

Clays however that have been moved, carried down by the rains, and re-deposited are, in comparison, rather easily disintegrated and washed away.

On the lower parts of many of the steep slopes the soil and stones carried down during the monsoons form distinct but irregular layers and (though rarely) strata somewhat resembling alluvial deposits. Heaps of gravel and partially water-worn stones accumulate in the beds of the torrents, where there is a sudden change of level, caused by a hard bar of rock or a fall of rock, and the torrents, as their beds are deepened and the courses are changed, have these loosely-formed beds as walls on one side or other, rarely at the same spot on both.

The numerous roads in the Wynaad at various heights and in many cases nearly paralled to each other, whether made by the Government for the purposes of general traffic or by the planters for convenient access to various parts of their estates are invariably well made, and the traces are good. They are sideling roads: the bank on one side of the hill is cut away and the excavated earth and rock are made to form a part of the road.

They are necessarily, in a hilly country like that of the Wynaad, contour lines, and the maps which accompany this report shew in what directions they run; and, in the absence of a correct orographic map, give some hints as to the general features of the country.

In cutting these roads very many fair sections of the rocks and some quartz veins have been exposed: and the mineralogist and geologist find at numerous points as they travel along them much that instructs both as regards the character of the country rock, its mode of decomposition and its conservation, as well as the rather peculiar character of the "leaders," "strings," and

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small veins which are, as it were, thrown off from the main reefs of quartz.

Rocks—The granitoid schists or gneissoid rocks of South-East Wynaad are, it is probable, as will be shown hereafter, only completely metamorphosed sedimentary strata. The minerals observable are felspar quartz, hornblende, mica, talc, chlorite, pholerite, and magnetic iron. The ordinary foliated rock is usually massive or composed of thin compact layers of quartz and felspar, or of quartz and hornblende. Magnetic iron takes the place of one or other of these constituents, or accompanies them in some places, and at and in the neighbourhood of Marpanpadi North Peak, magnetic iron is largely present in the rock, the decomposed surface stone exhibiting layers and reniform and nodular masses of sesquioxide of iron. Some specimens are composed almost entirely of quartz and magnetic iron, and in others the iron occurs with quartz and felspar; and again there is a variety composed of translucent quartz, magnetic iron, and an asbestiform mineral resembling iron amphibole.

Bands also have been observed in which the proportion of iron pyrites in disseminated crystals is very large.

Massive hornblende rock is found on the south-east, and garnetiferous foliated gneissoid rock is common towards the north and east.

In many places the country rock, besides being intersected by large persistent reefs of quartz, is seamed and veined throughout with threads and strings of quartz; not in any way conformable to the lines of foliation; and where a section of the rock decomposed *in situ* is laid bare, these threads and strings are clearly traceable through the red, reddish brown, and dark brown of the kaolin-like clays resulting from the decomposition of the stone. These veins vary from one-eighth of an inch or less to six inches or more in thickness, and they consist either of white opaque or blue opaline quartz, the latter not unlike that which forms thin layers in the foliated country rock.

In more than one locality near Devala, the harder rocks consisting of dense quartzite or quartz with magnetic iron and a little felspar appear as large rhombohedral blocks or as symmetrical hexagonal or square prisms; and the faces of the planes are not seldom covered with thin layers of rather dark blue opaline quartz. Many of the forms are of singular interest, and a stranger might without examination suppose that some of the masses were of igneous origin. It is perhaps needless to say that the shape of these blocks is due to the direction of the several systems of divisional planes or joints.

The modes of decomposition of the several varieties of gneissoid rocks in the Wynaad give hints as to the degree of metamorphism to which they have been subjected. For instance, where not intensely metamorphosed, they do not weather into spheroids nor exhibit concentric layers around a hard core of rock, such as one sees in tracts occupied by granitic, trappean, and the older igneous rocks. Where, however, there is a greater development of the crystalline structure, as in some parts of the country west of Devála, this well-marked feature presents itself.

East of Needle Rock and east of Harewood thin micaceous shales occur which remind one of the typical micaceous lower Silurian rocks; and the lines of lamination in the former might well seem to correspond with the cleavage planes of the latter. The strike of these thinly laminated micaceous shales east of Needle Rock is N. 55° W., being nearly at right angles to the general direction of the folia of the gneissoid rocks. It is perhaps correct to say that observation has shown that the most productive auriferous belts in the Wynaad are those in which these micaceous and chloritic rock occur; and that as a rule where the hard dense massive quartzo-hornblendic strata are found, and where the foliation is indistinct, the veins are either absent, or, where present, consist of saccharoid quartz with large and small plates of mica.

The foliation of the rocks in that part of South-East Wynaad already described preserves throughout a nearly uniform strike, namely, N. 54° E.—S. 54° W. There are curves however where the direction varies from N. 40°

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E. to nearly east and west. The dip is southerly and south-easterly from 60° to vertical.

Only an extended examination of the country, such as would be made in the course of a minute geological survey, would enable the observer to offer suggestions as to the probable origin of these metamorphic and metamorphosed rocks. It is apparent wherever they are well exposed that there is one system of planes very like strike-joins which, but for the direction of the dip, might be supposed to represent planes of original deposition. The direction of these in some degree accords with the general direction of the main quartz veins, and it might be surmised on a first view that the formation of the latter was due to the same forces which operated in altering the strata they intersect; that in other words, the quartz in the veins was segregated during the enormous period which elapsed from the time of the first slight alteration of the original sedimentary rocks until they were metamorphosed as we see them now.

In the *Manual of the Geology of India* it is stated that "this Nilgiri strike is noted as distinctly that of the lamination and bedding of the gneiss as well as of the foliation," and therefore it is the more difficult to conjecture to what forces the direction of the quartz veins is due, coinciding as it does, not with the foliation, but rather with the system of joints above referred to.

While the strike of the rocks over a large part of Australia is nearly meridional, the reefs also have generally a north and south direction.

The stronger and more persistent veins as they appear at present may represent what were once lines of least resistance, and some speculations of a strictly geological character might follow this suggestion if this report were not confined to questions of a practical character.

Much valuable information is to be obtained respecting these rocks from the reports and map prepared by Mr. King. A sketch of a geological map of South-East Wynaad on the scale of four miles to one inch, published with the records of the Geological Survey of India (May 1875), and which I had not the opportunity of seeing until after much of this report was written, shows alternating bands of felspathic gneiss and chlorite gneiss running north-easterly and south-westerly, as well as a large area occupied by quartzo-hornblendic gneiss (Nilgiris) and the smaller areas of granitoid gneiss at Yeddakilmullay and Munnaymulla.

There is an absence of intrusive rocks in South-East Wynaad. There are no dykes or masses of porphyry, no basalts or recent volcanic rocks; and it is only at one point, as far as is known, where greenstone occurs, namely, on the Hamsluck estate. The rock consists mainly of hornblende with a small proportion of felspar (oligoclase).

Near the spot where this rock is exposed there are veins of granite, or perhaps, to speak more correctly, veins of quartz which are essentially granitic. In several places, more particularly at Gúdalúr, Cherambádi, Moopenaad, and Velliry-mulla there are masses of quartz with large transparent plates of mica. The micacisation of the quartz is observed most frequently (but not invariably) where the veins are very thick; and from the observations which have been made up to the present time it might be inferred that gold, in such proportions as it is found in veins which are free from mica, is rarely present in these micacised reefs.

It is not yet certain that the "country rock" is commonly less silicious in those places where the quartz veins are numerous, but this peculiarity is to be noted in the neighbourhood of Devala.

General character of the auriferous quartz veins.—The quartz veins of the Wynaad differ in some respects from those intersecting the almost unaltered lower Silurian rock of Australia, but they are usually as thick, or thicker; and quite as persistent. The auriferous veins, those which have yielded well both on the large scale and by tests in the laboratory, are laminated and more or less pyritous, and those which up to the present time are regarded as less auriferous are composed of saccharoid, often snow-white opaque quartz with transparent particles

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of quartz impacted, and have generally an obscurely granular appearance—more indeed like quartzite than vein-quartz, and in many places, as already stated, they exhibit a tendency to become grantic, large plates of muscovite and apparently a hydrated muscovite in smaller plates, with here and there a little felspar giving them a character which separates them at once from the well-known rich pyritous veins near Devala. Some of the massive quartz near Moopenaad and Vellirymulla micacised and in structure simulating granite, or partaking of the character of the country rock, might well be supposed to be bedded and not vein-quartz and contemporaneous with the gneissoid rocks with which it is associated. There was no true quartzite seen in these places, but it may be conjectured that the induration and alterations of compositions and structure, which have resulted in the formation of the foliated gneissoid rocks would not be without influence on purely silicious granular interbedded masses.

From the larger (true) veins "leaders" are thrown off, most commonly to the westward. The leaders usually dip at a low angle, but in some places they are so large and of such a form as almost to give the character of "saddle" reefs to the masses of quartz.

The ordinary "casing" of the reefs is a talcose schist (easily separable into thin laminæ) with oxide of iron and the minerals ordinarily therewith associated; and gold in small flat particles, visible to the eye, is not rare in the casing. The casing of many of the large auriferous reefs is quartzose and ferruginous, rudely laminated and with scales of ripidolite and talc scattered through the mass.

The average thickness of the true quartz veins is about five feet. Some are less than two feet in thickness, and others again exceed fourteen feet. The greater number, however, vary from four to seven feet. The direction of the veins is usually N. 30° W.—S. 30° E., and some are nearly due north and south; and the dip, though nearly always easterly, is irregular. On the summits of the steep hills the veins are commonly almost flat or with a very slight dip to the eastward, but at a little depth from the surface the dip is, as might be expected very different. It is not seldom as much as 30°, 40°, and 60°.

These sudden variations may be due partly to the changes produced on the surface by the heavy rains which fall yearly. Much decomposed and almost solid rock is moved in masses, and "the action of gravitation on substances loosened by weathering, or the 'weight of the hill' as it has been called, would account for the difference of dip as measured near the surface and at some depth from the surface.

The direction or strike of the quartz veins is, in a district like the Wynaad, broken up, as it is, into rounded hills of varying height not easy to trace, unless regard be had to the elevation of each point where an outcrop of quartz is seen. An outcrop on a hill is thrown to the westward, and the same reef outcropping in a valley is necessarily eastward of the line which would appear if the ground were of the mean level.

It is not yet possible to say what number of separate veins of quartz there are in the area which has been examined, but there are at least two hundred outcrops—not necessarily distinct reefs.

From Moopenaad to Cherambadi, a distance of eleven miles and-a-half by the road, twenty-three outcrops were observed, many of them indicating reefs of great thickness; from Cherambadi to near Nadukani in a straight line south-easterly, twelve miles, there are at least eighteen separate veins; and east and south-easterly of Devala the reefs are from 5, 5½, 7, 10, 16 and 23 chains apart.

Between Moopenaad and Cherambadi the rocks are in places arenaceous.

Distribution of Gold.—As will be seen from the detailed reports which follow, gold is almost universally distributed throughout the soils and quartz veins of the Wynaad. It occurs also in the sands and soils both on the east, west, north, and south.

In South-East Wynaad, on washing a few dishes of the surface-soil anywhere, a few specks of very fine gold will be found; in the vicinity of the reefs

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rather heavy gold is often got by sluicing; and if a suitable spot be selected, the native miners will obtain, even by their methods, sufficient gold to remunerate them for their labour.

The character of the rocks, the nature of the climate, and the formation of the country have all contributed to prevent the accumulation of drifts such as are found in California and Australia. There are here no gullies having in their beds shallow deposits with a well-defined auriferous stratum, no "deep *leads*," covered and protected by layers of volcanic rock; there are only, as a rule, in the district now under consideration "surfacing" and "quartz-mining."

On the Seeputtee river there is an accumulation of well-rounded boulders of quartz and gneissoid rock imbedded in hard clay and sandy soil which may be regarded almost as a "cement." It is no more than the old bed of the river, which owing to the "cutting back" action of the water has lowered its level and left this drift on its banks. It is probable that, as in other similar cases, the "cement" will be found in patches on both sides of the river, in places which were formerly bends of the old stream. The bedrock on which the gravel, clay, and boulders lie is at no great height above the level of the existing water-course; and the part of the drift which has been worked is about thirty feet in thickness.

This drift and those which are to be found in the beds of the swamps may be said to represent the alluvial deposits of the Wynaad. Some of these are probably rich in gold, but it is only under favourable conditions that they could remunerate the miner.

It would be extremely difficult and costly, and in many cases almost impracticable, to drain the swamps by artificial channels, and the expense of pumping the water from a shaft would be very great. Still, if the lowest stratum should prove to be highly auriferous, it might be found remunerative to resort even to pumping, care being taken to carry off the surface water from the swamps by constructing races.

Below the Wynaad plateau and bordering on the tertiaries there are in the beds of the streams rather deep deposits of drift. At Karambaut the water-worn gravels and rounded blocks of country rock and quartz are of considerable thickness.

Below Eddacurra the bed rock is covered with quite recent deposits and tertiary strata (laterite). It is not known whether the stratum immediately overlying the bed-rock is generally auriferous; but wherever the latter is intersected by quartz veins, more or less gold will be found in the disintegrated rocks.

Mining for gold in Malabar in former times.—From the appearance of the mines and the soils on the slopes of the hills, it is almost certain, as stated elsewhere, that gold was worked in Malabar at a very early period. This, however, is only conjecture. The industry has no history. The wealth of the native rulers in former times, the buildings erected by them, and the records relating to their wars all point out, however, to the conclusion that gold was derived in large quantities either from the Peninsula or perhaps from some neighbouring country.

Ground-sluicing.—In getting gold by "ground-sluicing" the Korumbars display much ingenuity. One old miner usually directs the operations. Having fixed on a spot where he thinks there is a probability of finding gold he "prospects" the area, using the *murriya* for washing the earth.

On a site being chosen, if it is not actually in the bed of a stream, a supply of water is directed to the spot by a race, and work is commenced. The men excavate the earth with their mamoties, the water all the while flowing over the space in which they are working. One man stands behind the other at such a distance as to permit of his using his mamoty, and in a short time three or four men are labouring knee-deep in water: the large stones are put aside, so that finally a wall is formed. The men are usually careful in washing the stones, and they exhibit no little skill in turning every slight advantage to account. The soil is stripped to the bed rock, every crevice

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is scraped with the mamoties, and at length the resulting heavy material having been concentrated by being raked up against the stream, the old miner steps into the channel with his *murriya* in his hand and fills it with the sand, &c., piling the stuff as high as he can on the dish. A little pool meanwhile having been made he places the wooden vessel with its weight of sand in that and "puddles" the sand, always scrupulously washing and examining the small stones before he throws them away. By tilting the dish and adroitly moving the stuff with one hand as the water flows over it he finally obtains a black, heavy, iron sand, and on this being sufficiently concentrated, the vessel is filled with water, a swinging motion is given to it so as to throw the gold into or a little above the hollow in the centre, and then again tilting the *murriya*, he takes water in one hand and allows it to fall through his fingers on to the sand in the lower part of the dish, and thus in a little time clears the dish of the refuse, and at length is able to show the gold almost completely separated from the black sand.

The washing is continued dish after dish until all the material concentrated in the sluice has been treated. The Korumbar's skill in manipulation is very great and he is also patient and painstaking.

When the gold is got together it is put into a leaf, and any black sand in it is washed off.

The operation of washing a dish of stuff usually occupies half-an-hour or more.

The *murriya* is made of hard, heavy wood. It is from eighteen to twenty-two inches in length, sixteen inches in breadth, and from two to three inches or more in depth. There is a projecting pin at one end and a knob at the other. It becomes smooth and black by use and shows the smallest particle of gold quite clearly.

In many parts of the Wynaad District the remains of the walls built by the miners when ground-sluicing, the lines of their races now almost obliterated, and heaps of rubble extending in some places over many acres, are to be seen; and in the jungles on cutting into the earth on a hill side, one finds that soil has been disturbed. Indeed the evidences of the patient labor of the native miners are so numerous and are found in so many localities that one pauses to consider the length of time which must have elapsed since gold-washing first became an established industry in this part of India. The soil and rubble made to yield its gold in times long past is now again consolidated, covered with herbage, and supporting large jungle trees.

Washing with the pautty.—The box used by the natives for washing auriferous earth more resembles a puddling through than a sluice. The *pautty* is a trough made of wood. It is from six to seven feet in length and one foot or more in breadth. On discovering a spot where there was a sufficient quantity of auriferous earth these boxes were employed; and it would seem from the report of a Committee appointed, under date 14th December 1832, to examine the gold mines in the Zilla of Malabar, that when they visited the mines near Mambat (Beypore river) there were fifty or sixty Moplahs at work.

The Committee state that the *pautties* were placed over a running stream; or water was conveyed to them in races. The boxes were placed in a sloping position. At the lower end small pieces of bamboo were laid across which acted a "riffles." Two men, the Committee state, were required to work one *pautty*. One day they collected the earth and the next day they washed it. The earth was carried to the *pautty* in the *murriya*, and the men stirred the earth with their hands, removing the stones, &c., until only heavy sand remained. This residuum was washed in the ordinary way in the *murriya*, and quicksilver was used to collect the gold, the amalgam being afterwards wrapped in a rag and placed between two pieces of burning charcoal until the heat volatilised the mercury and left the gold clean.

The *pautties* were used during the wet season on the higher lands, and in the dry season in the beds of the streams.

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Working veins.—Throughout South-East Wynaad and at several places in the low country of Malabar the quartz veins have been worked by the natives. The appearance of the workings indicate the following methods of getting out stone:—

(1) Quarrying on the outcrop of the veins (surface workings).
(2) Vertical shafts.
(3) Adits.
(4) Vertical shafts with adits therefrom.
(5) Shafts on the underlie.

Quarrying on the outcrop of the veins was undoubtedly followed in the first instance. Gold was seen in the stone, and blocks were broken in order to procure fragments with gold visible. It is belived that no stone was crushed which did not show gold,

Subsequently vertical shafts were sunk, but by what tribe is not known. Many of them are well formed, always round, and as deep as seventy feet or more. Some are in solid quartz, others in country rock intersected by "leaders" and thin veins of quartz. How the miners could possibly have sunk such shafts in hard dense quartz with the tools they had is hard to guess. They are plumb and the sides are quite smooth. It is not uncommon to find a number of shafts very close together, not more than a few feet apart. The adits in most cases were evidently constructed long subsequent to the sinking of the vertical shafts; where the latter are found on the summit of a hill, they are undercut by adits; and in some places care has been taken to block up the shafts so as to prevent stones and earth falling in on the miners below. It is unreasonable to suppose that several vertical shafts would have been sunk close together after the adit was driven. They could not have served any useful purpose. And the miners who constructed the adits did not generally sink vertical shafts in following the reefs downwards from their adits; they sunk shafts on the underlie or foot-wall, and these are to be seen in various places.

Towards the north-west another system was employed. In mining on the steep slope of a hill a vertical shaft was sunk to the depth of six or eight feet so as to cut the reef, and an adit was driven therefrom. With what object this method was adopted is not known; but it may be supposed that in some situations difficulties were found in protecting an open cutting from the rains. A cutting necessary to get a "face" in the solid rock would present surfaces which would be to some extent affected by the rains; whereas by sinking a shaft (at all times easily protected) the miners were able to penetrate the hill with safety, though the additional labor involved in getting out stone would be great. There are, as already stated, not a few shafts sunk on the underlie in several localities near Devala. The reefs were mined in this manner, it is almost certain, by the same class of miners as made the adits.

It was not unusual for them to penetrate to the depth of sixty or seventy feet, but where the reefs were flat or had a low dip, these underlie shafts were only inclined adits, rising where they worked at the casing of the hanging wall and falling again as they followed the foot-wall.

In what manner soever the auriferous quartz was procured the after-treatment was in all cases nearly the same. The quartz broken into small pieces was given to the women to grind. Each woman was provided with a muller or hand-stone, and fragments of quartz were either ground on a suitable piece of stone *in situ* or on a large flat stone procured for the purpose. The pounded stone was subsequently washed in the *murriya* and the gold got by amalgamation with mercury.

The auriferous stone was sometimes roasted. Whether merely to effect its disintegration more easily and rapidly, or whether from a knowledge that the pyrites in it were auriferous, has not been quite satisfactorily ascertained.

It is probable, however, that some of the miners knew that the pyrites

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contained gold though it was not visible to the eye, and that by roasting the mineral they would get it. In one locality it was usual for the miners to procure blocks of pyrites, divide them, and take the pieces to their homes for treatment.

In breaking up blocks of quartz too on the outcrops of the reefs, it is said that they used fire. In one place, according to information given to me, the trees of the jungle were felled, the timber piled in heaps on the quartz and there burnt, and on the outcrop of one reef an excavation in the solid rock was found which appeared to have been constructed for and used as a kiln.

Where the quartz miners have labored there are to be seen usually large heaps of broken quartz, the pieces rejected because they did not show gold; and on the out crops of the reefs are found the smooth hollows in the rocks worn by long hand-grinding, while in the jungles, the flat stones and mullers, covered with moss, are occasionally met with.

It may be interesting to remark that these flat stones and mullers are very similar in form to those used by the Australian natives for grinding seeds, &c.

The miners who worked in the adits seem to have had more knowledge of mining and of the modes of occurrence of gold than those who formerly got out quartz by sinking vertical shafts. The former followed the run of gold wherever they were able to do so, sometimes taking out the foot-wall and "casing" and sometimes the hanging wall.

The Korumbars, skilful as they are, have no knowledge of the manner in which the gold has been distributed. They are acquainted with the "run" of the reefs and show great intelligence in selecting spots likely to yield gold, but they do not believe that the gold in the soils has been derived from the disintegration of the reefs. They say that it is found in some places in the reefs, in other places in the soils, but that its occurrence in the latter is in no manner connected with the former.

Machinery for treating auriferous quartz, &c.—The machinery and appliances for crushing auriferous quartz and saving gold are simple in themselves and easily managed when the principles on which they are designed are understood. Neither that portion of the work of reduction which is purely mechanical, bringing the mineral into such a state as to admit of metallurgical treatment, nor the metallurgical treatment itself is of such a character as to call for more than the knowledge which is to be gained in any large quartz-crushing establishment. A competent superintendent may not be an engineer nor a chemist, but he should have a sufficient acquaintance with mechanics and mechanical processes, and he should be familiar at least with the chemistry of the metals and minerals with which he has to deal.

The machine for crushing quartz consists of a series of stamp-heads arranged in batteries of four or five. To each stamp-head is attached a lifter with a circular disc. A horizontal shaft, provided with wipers (so placed as to catch the discs) when put in motion causes the stamp-heads to act as so many pestles. The wipers are arranged in such a manner as to make the stamp-heads in each battery fall successively, but the order in which they fall is not the same in all mills; and each stamp-head rotates, making part of a revolution each time that the wiper catches the disc.

The stamp-head moves in an iron box or coffer having spaces covered with perforated plates for the passage of the crushed quartz. The bottom of the coffer is packed with broken quartz to the depth of three inches, and on the broken stone lies the false bed of wrought iron.

In the best mills the stamp-head with its shank or lifter weighs from 6 cwt. to 8 cwt., in some the weight is as low as 2 cwt., and in others as high as 9 cwt. The height the head falls varies from 6 inches to 15 inches, and in the number of blows per minute there is a wide range; in one mill the number may be no more than 45, and in other 85.

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Connected with the mill there ought to be one or more machines for breaking the blocks of quartz into small pieces. When the quartz is brought to the mill, the smaller pieces are picked out and sent direct to the stampers, and the blocks to the stone-breakers. A stone-breaking machine will break about eight tons of quartz per diem. As the price of labour is very low in India, it might be practicable to have all the stone broken by hand, but the saving effected (if any) by employing manual labour would be very small.

A self-feeding aparatus is almost indispensable. It not only saves labour, but also ensures regularity in feeding.

The water trough is usually placed under the self-feeding hopper.

In front of the coffers are three or more troughs containing quicksilver, and below these are the tables. The tables should be evenly and securely fixed and in such a manner as to admit of the inclination being altered if necessary. They should be at least twenty feet in length. The strakes (subdivisions of the table formed by fastening narrow strips of wood to the floor) should be about fourteen inches in breadth. In all well-planned mills there are breaks in the tables, generally at intervals of three feet, the upper edge of the lower strake being about two inches below the slightly overlapping edge of the one above. The tables should be made quite smooth, and the utmost nicety is required in setting them, so that the inclination may be the same throughout, and any line at right angles to the strakes absolutely horizontal. The same care should be employed in putting on the blankets; they should lie flat and cling to the boards.

Closely-woven green baize is perhaps the best material for blanketing.

At the extreme end of the tables there is another trough containing quicksilver, and finally a waste trough through which the sand, pyrites, lime, &c., pass to settling boxes.

The boxes are cleaned out from time to time during the working day, often at intervals of a few hours.

The separation of the pyrites from the sand &c., constituting the tailings is now generally effected by some form of buddle.

Borlase's buddle with Munday's patent scrapers is believed by many to be the best. It consists of a circular wooden trough or basin from eighteen to twenty-four feet in diameter. It is about one foot six inches in depth. The tailings consisting of crushed quartz pyrites, &c., are made to pass along a sluice and fall into a box whence they are conveyed by pipes to the sides of the trough. The greater specific gravity of the pyrites causes the mineral to separate from the quartz sand and to remain on the floor of the buddle, while the latter being carried down the table passes away through a discharge pipe. In order to prevent the loss of the valuable material, two or three rims or stops are fixed on the floor of the basin. The pyrites are raked by knives, which, as well as the pipes conveying the material to the trough, are made to revolve round the central shaft. A machine making seven or eight revolutions per minute is recommended. The knives are raised or lowered by means of screws*.

The concave buddle has had the attention of mechanical engineers for some years, and several improvements have been adopted from time to time. Other ore-dressers have also undergone modifications with a view to fit them for the use of the gold miner, and some forms of percussion tables have given good results.

The pyrites, however excellent the system of concentration may be, are never entirely free from a certain proportion of quartz sand; but this is not to any serious extent objectionable when the material comes to be roasted in the furnace. Numerous forms of furnace have been devised for roasting pyrites; one kind

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* A description and a plan and section of Borlase's buddle are given in the Report of the Board appointed to investigate the methods of treating pyrites in Victoria. And descriptions of other forms of buddles are contained in the "Gold Fields and mineral Districts of Victoria."

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after another has been tried, and it has been found in this as in all other appliances for treating auriferous pyrites and auriferous quartz, that the simplest plan is invariably the most efficacious. An inclined reverberatory furnace on the following plan is highly approved of in Australia:—It consists of a fire-box from which the heat and products of combustion pass over a hearth into condensing chambers. The charge is supplied through a hopper and gradually drawn down over the hearth by rakes until it reaches a channel near the fire-box, whence it is drawn into a pit at the side of the furnace. Four or five small doors are provided into which the rakes are inserted. As the charge is drawn downwards to the bottom of the hearth it becomes gradually heated more and more, and to such a degree as to decompose the sulphides. The roof of the furnace over the hearth should be arched.* In a well-constructed reverberatory (oxidating) furnace all the sulphides thrown into the bed are completely decomposed in a short time.

A dull red heat is maintained throughout, and until the sand is actually raked out into the pit, there is a continuous stream of heated air playing upon the pyritous minerals.

Methods of testing auriferous quartz and auriferous pyrites.—Only by a careful chemical analysis can the proportion of gold in any given quantity of quartz, pyrites, or other mineral be ascertained; but for all practical purposes, assays by amalgamation are sufficient. The methods pursued in treating quartz taken from the reefs in the Wynaad have been as follows:—

When a reef was tested in sections, the stone from each section was taken out in far larger quantities than were required for testing; each heap of quartz was broken into small pieces, and the whole was well mixed, and from the heap so mixed the portion to be treated was taken. The stone was broken still smaller and weighed, and it was then ground very fine on a suitable stone, another stone being used as a muller. The finely pulverised stone was put into a clean iron pan and roasted until fumes were no longer given off until it was certain that it was in a fit state for amalgamation. If after roasting the pulverised material seemed to require it, it was again ground on the stone. The heat at all times was so regulated as to prevent the possibility of "glazing."

The roasted stone was put into an enamelled dish, and a proper proportion of quicksilver was added.

The whole was then thoroughly rubbed by hand, at first dry; subsequently a little cold or hot water was poured in until a paste was formed; more water was added, the stuff being thoroughly rubbed all the time, and finally the amalgam or (if there was no gold) the quicksilver was washed off, the utmost care being taken to prevent the loss of any quicksilver. The water and sludge from the enamelled dish were poured into other vessels and these were most carefully examined subsequently, and if there was doubt,—and sometimes when there was no doubt as to the results, the sludge-sand, &c., in these were treated again,—the amalgam or quicksilver was most often placed under the flame of the blowpipe, but at other times nitric acid was used and the gold (if any and of sufficient quantity) was weighed.

The results were calculated in the ordinary way,

It happened occasionally that the roasting was not sufficiently protracted, or that all the material subjected to the roasting was not ground as fine as it ought to have been, and then it became necessary to subject it to further roasting, or to use acids to decompose the sulphides. In all cases the utmost care was taken to preserve the conditions necessary for effective amalgamation.

The quartz collected in various localities was treated in the same manner as that taken from sections of the reefs.

In order the better to illustrate the value of this system of testing quartz, I took a quantity of sludge and sand from which the gold had been extracted, and which had been saved in pans, and into this I put half a grain of very

* Report of the Board appointed to investigate the methods of treating pyrites, 1874.

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fine gold. The gold was well mixed with the sludge, &c.,—quicksilver was then added, and the operation of amalgamating performed in the ordinary manner. The amalgam was treated also in the ordinary manner, and the gold recovered weighed ·4786 grains nearly, showing that the loss was 4·28 per cent. The loss may be partly accounted for by the mere handling of the fine gold in a very damp atmosphere, *i.e.*, weighing it, transferring it to the dish of sludge, &c., and re-weighing it. This system however is, when very carefully managed, so certain, that if the actual assay produce of a parcel of quartz was at the rate of one ounce per ton, the gold got by amalgamation would weigh 19 dwts. 3·5 grains. It will be observed that the result in every case must necessarily be slightly in defect, never in excess. Messrs. Johnson and Matthey, the well-known Analytical Chemists, in a report to the Directors of the Port Phillip and Colonial Gold Mining Company, make the following statement :—

"We finally had recourse to amalgamation, and were surprised at the ready results so obtained(having been led to suppose that the mineral—pyrites—was unworkable under that process) * * * * * * The results recorded by the Analysts are highly interesting :—

	oz.
The pyrites (raw) gave by 'assay'	11·425
Obtained by amalgamation	10·400

"The pyrites exposed to the decomposing influence of the atmosphere from 15 to 20 days being laid out in a thin layer and occasionally stirred :—

	oz.
Assay	11·425
Obtained by amalgamation	10·850

"The pyrites calcined in an ordinary calcining furnace slowly and at a low temperature :—

	oz.
Assay	11·400
Obtained by amalgamation	11·275"

The loss by the amalgamating process was in the first experiment 8·97 per cent, in the second 5·04 per cent, and in the third 1·1 per cent.

MINERALS OF THE SAN FRANCISCO VALLEY, BRAZIL.

(From the *South American Journal*, May 12th, 1881.)

The following is taken from the report of Col. W. Roberts:—

Gold.

Almost all the basin, from Piranhas to the heads of the river, is known to be auriferous, and perhaps no region of the world has undergone so many trials as those parts of the basin which belong to Minas Geraes and Goyaz, wherein a great extent of the surface has been literally turned over in quest of the precious metal.

To judge by the appearance of the country, and the bad success of many recent attempts, the gold of the region is exhausted. But without being able to form an authoritative opinion, my study of the matter having been too limited, I am far from supposing such to be the case. At least the ill-success of many promising undertakings should not be taken as proofs, inasmuch as many causes co-operated therein and they should be attributed largely to the difficulties of communication, to ignorant and extravagant administration, and to the ruinous speculations which have induced abandonment of the undertakings before the mines had been properly tested.

Gold appears in many modes in almost all kinds of rocks in the region, but for mining it is enough to treat of four of the modes, namely: pyritous veins, quartzite ones, beds of ferruginous quartzite known as itabirite, and superficial gravels and sands.

The known and worked veins of pyrites are those of Morro Velho, Cuyaba

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and Santa Barbara, in Minas Geraes. At times they have a great width (20 metres at Cuyaba), and, though not extremely rich, are very steady in value. Their gold is exceedingly fine and of difficult separation, requiring careful treatment and costly reduction.

The average value of the Morro Velho mineral is only about eight oitavas to the ton, but, being judiciously administered, this mine has been rendered, not only the best in Brazil, but one of the best in the world.

As yet the pyritous veins have proved to be the best when, as at the three places mentioned above, there is good management, and great quantities of ore have been extracted from them and treated. Their secret is economical work on a large scale, and, doubtless, there are many places where similar mines could be opened.

The veins of auriferous quartzite are more numerous but are smaller than those of pyrites. Many were worked in early times, and I believe there are some now in work.

The veins hitherto opened are of very variable thickness and inconsistant richness. Some places have been found extraordinarily rich, but they were soon exhausted, and none of the mines have been steadily prosperous.

The same can be said of the mines in the itabarite beds, in which the gold is usually distributed along certain lines. The famous mines of Congo, Secco, and Machiné are instances of almost fabulous richness in certain parts of these beds, and of the inconsistant character of the auriferous lines.

Besides the irregular distribution of the gold there are other difficulties to overcome in such mines. The rock is so porous that they are frequently liable to inundation, and so loose and friable that even with the most solid timbering it is difficult and costly to keep the galleries open. It would be worth while to try working these beds with a jet of water, as in California, as I am convinced by the experiments I have seen, that the material could be rapidly and cheaply excavated by that system. The only embarrassment is that the great specific gravity of the ferruginous sand would render the separation of the gold difficult by the common processes, but, probably, means of getting over this difficulty could be invented. Should the application be successful, new horizons would open to mining.

The superficial deposits are those which have been most extensively worked. They lie in great abundance in the valleys and extend along both sides on the hills. Great sheets of gravel, covered with more or less soil, show themselves likewise on the hills and mountains at a distance from the streams, and appear due to denudation and not to surface waters. No valleys of ancient rivers like those that characterise California have been recognized, and there are no proofs of the action of the causes which produce such deposits by change of the old system of drainage.

Using the old system of dish and canoe, it may be said that in general these deposits are exhausted, and they have all been abandoned. Still, it is a problem to decide whether they could be worked profitably with modern methods. The old miners, though they employed a slow and tedious process, had the advantage of disposing of exceedingly cheap labour, and it has to be proved that modern miners could remove and wash a given quantity of gravel as cheaply.

It is a mistake to suppose that the ancient miners did not understand and use the action of running water in their mining. The hills of Minas Geraes are grooved with old ditches, often leagues in length, and therefore comparable with modern hydraulic works. What they did not understand was the great advantage of the hydraulic system—that of bringing the water under *pressure*.

The region presents great facilities for the employment of this modern system of mining, and it is probable that there are places where it could be applied profitably, for it is another mistake to suppose that there are not remunerative places to be discovered and worked, and that all those worked and abandoned were exhausted or judged so by the miners. History here shows that mining always dragged on a precarious existence, because of the foolish repressive

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laws of the Portuguese Government, and, indubitably, frequent abandonment took place of promising places whose working was not renewed when the restrictions were taken off.

The possibility of discovering new virgin deposits has been shown by the recent discovery of a rich diamantine deposit at the Jequitahy. No region was so prospected as was that lying west of Diamantina by the "garimpeiros," or "diamond poachers," who, driven like wild beasts from the diamond demarcation, spread all over that region, trying the ground everywhere in search of gold and diamonds, yet up to 1874 the richness of the Jequitahy was unknown.

The foregoing observations apply especially to Minas Geraes, with which I am best acquainted, but there is no doubt they are as applicable to Goyaz and Bahia. Traditions of immense riches are common in both provinces, and, allowing for exaggerations, there is certainly much to be explored. The valley of the Rio Verde, in the comarca of Chique-Chique, Bahia, is one of the most famous in the traditions. With facilities of communication, a good mining law, an active and enterprising population, and, finally application of the most improved systems of mining, the auriferous deposits of all kinds existing in the basin of the San Francisco may yet again vindicate their primitive fame. The Ouro Preto Mining School should, if properly supported, contribute greatly to such result.

CEYLON GEMS.—With reference to your paragraph under the heading "Propable Increased Demand for Ceylon Gems," which appeared in your paper of the 4th instant, you will probably be surprised to learn, that there has been an utter absence of demand in the London market for Ceylon precious stones for some considerable time, owing to the continued large receipts of blue sapphires from Burmah. A parcel of blue sapphires and cat's-eyes, which has been in the hands of a first-class London house for some time, and which had been valued at over £1,000 eighteen months ago, has now been, owing to the stupid policy of holding, re valued at only £250!! and it is most difficult to get a bid even at this figure.—*Cor.* "*Ceylon Observer*," June 10th, 1881.

OF THE PEARL FISHERY ON THE COASTS OF CEYLON.

(*From Ribeyro's Ceylon by George Lee.*)

Having now related all that we know of the natural riches of the land of Ceylon, we shall describe those which its sea produces. The pearls which are procured from the coasts of the island, and more especially from Aripo, are of the highest value. As few persons know how that fishery is conducted, we shall here relate what we know of it.

At the beginning of March there assemble on that coast 4 or 5,000 boats got together and paid by Moorish or Heathen merchants and by some Christians. These merchants have many partnerships among themselves, and they first make up a fund to arm four, five or six boats, more or less, according as the entire adventure is greater or smaller. Each of these boats has generally from ten to twelve sailors, one master, and eight or nine divers. All the boats go out together, and seek when the fishery is likely to be most profitable; and they anchor at the spots where the sea is only five, six or at most seven fathoms deep. Then they send off three boats to a league distant round-about, each in a different direction; each of these boats brings back a thousand oysters. These are opened in presence of the merchants, and the pearls found in them are examined by the whole party and their value estimated, as the pearls are much finer in some years than in others, and accordingly as the merchants find the pearls to be large, clear, round and of good water, they bargain with the king for the fishery of that year. When the bargain is made, the king usually gives them four vessels of war to defend them from

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the Malabar and other pirates.* Then each merchant goes to the sea-side and constructs a sort of enclosure with stake and thorns, only leaving a narrow passage for the boats to enter and go out again, which come there to discharge the oysters they have fished up.

On the 11th of March, at four in the morning, the officer in command of the four vessels of war fires a gun as a signal, and immediately all the boats put off to sea, steering for the place which they have selected to fish at and casting anchor there. Each of these boats has on board stones of the weight of sixty pounds each, fastened with strong ropes, of which one end is attached to the boat. The diver places his foot on one of the stones, and passes another rope round his body, to which is tied a basket or a small woven bag like a net; this second rope is held by two of the sailors, and the diver thus secured descends into the sea; he remains there whilst two *credos* can be said, and fills his little bag or basket with oysters, which he sometimes finds in heaps on the rocks; as soon as his basket is full, he makes a sign by pulling the rope held by the sailors in the boat, and one end of whch is round his waist, and they draw him quickly out of the water; but if in the time he is below, he can contrive to open an oyster and finds a pearl in it, it is considered his own; as soon as his head is above water, another diver goes down, and thus they descend by turns. This fishery lasts till four in the afternoon, when the officer in command fires another gun as signal to cease the fishery for the day. Then all the boats go to their several enclosures, and the noise and confusion that ensue in the two hours that are allowed to discharge and pile up the oysters, cnnnot be described.

Besides the people belonging to the boats, the children of the neighbourhood never fail to assemble at the sea-side offering their services, rather however to steal the oysters than to assist the sailors or merchants. As soon as the boats are unloaded, they put to sea again and go about half a league higher up by the sea-side, when the merchants assemble and hold a splendid fair; there are magnificent tents, and all sorts of merchandize of the most valuable kind are to be had there, as vendors come from all parts of the world. Heathens, Jews, Christians and Moors, all have some speculation for profit; some sell by wholesale, others by retail; the sailors and children bring the pearls which they have stolen, and people of every kind have bargains to offer. Persons having but a small capital, buy small ventures, which they immediately sell to larger merchants with a middling profit; not only pearls are bought and sold, but jewellery of every kind, bar-gold, dollars, fine Turkey carpets, and beautiful stuffs from India.

The fishery lasts from the 11th of March to the 20th of April, but the fair itself continues for fifty days, because for the last nine days the enclosures are cleansed, as so many flies are bred by the corrupt matter, that the adjacent places and the whole country might be annoyed by them, if care were not taken to sweep into the sea the impurities collected during the fishery:

On the last day of April, the merchants of the several partnerships assemble together and share the pearls belonging to their respective boats. They separate them into nine classes, and set on each class a price according as the demand has been greater or less for pearls during the year; when these prices have been set on them, they make the allotments and shares. Then the ill-formed pearls are sold at a sufficient moderate price; the small seed-pearls are left on the sea-side and the country-people come in the spring and sift the sand for them and sell them for a trifle.

Note by the French Editor.

*** An escort of armed men always accompanies the Pearl-divers, on account of the Malabars, who come from the coast of that name or from the Maldives, and who live by piracy, so that no boat, canoe or práhu is safe in those seas. The fishers or divers cease their work at noon, on account of the swell caused by the wind, and which annoys the divers, who can only descend in calm weather.**

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Hence the pearls and seed are send to all parts of the world. This is all I know of this fishery. But I must not forget to add that pieces of *amber* of a considerable size are also found on this coast. Great branches of *coral* also drift ashore when the sea is high; the black kind is better and more esteemed than the red.

CEYLON PEARL FISHERIES.

(*From the Hon'ble Geo. Vane's Report, to Governor Sir Henry Ward, 28th February,* 1863.)

Pearl Banks are believed to extend all along the N. W. Coast from Negombo to Mannar, and the charts and records contain the names and positions of 19 banks, but the larger portion of them have never yielded fisheries either to the Dutch or English Governments. The Condatchy Paar having only been fished in 1801, the Chilaw Paars in 1803 and 1815, the Karativo in 1832, and the Peri Paar Karrai in 1833, 1835, and 1836, so that the Cheval and Modragam have been heretofore, as now, the sources from whence the large, although precarious Pearl Revenues have been derived; and, judging from the results of the inspections I made in March 1862 of the entire coast and known banks between Negombo and Jaffna, I believe the general productiveness of the Cheval and Modragam is mainly attributable to their position being within the Karativo shoal, a means, especially the Modragam, of protection from the influences of weather and currents,—causes to which are attributed the frequent disappearance, before arriving at maturity, of beds of young oysters formed in other banks. But there may also be other causes to account for these two banks alone rearing oysters to maturity; possibly the ground is favourable for the settling of the spawn, or affords good feeding; if so, and I believe this to be another essential of these banks; then the, young oysters formed on other banks may find their way to the Cheval or Modragam, and in this manner I believe the latter banks to have been recently supplied with a portion of the oysters now thereon, from the Karativo Paar, which on October 1860, was well filled with young oysters that could not be found at the inspection of March 1862.

Notwithstanding that many long lapses have occurred between each series of fisheries, the Arippo banks have yielded very large revenues to the Dutch and English Governments; they were fished by the Dutch so far back as 1667, and with intervals gave fisheries up to 1768. This was the last under the Dutch, as a period of 28 years then passed without a fishery.

The Cheval Paar and Modragam are (as detailed in my Inspection Reports of November 1861 and April 1862,) abundantly, I may say, enormously stocked with oysters of an age that give the almost certain prospect of arriving at maturity. The Cheval Paar yielded during 1855, 1857, 1858, and 1859, 60,000,000 oysters, the fishing for many days in 1857 being from one million to one-and-a-half million. The extent of ground then covered was very much less than the present, and consisted of three separate patches or beds; now, an extent of ground over four miles long and one-and-a-half broad, is all fairly covered, excepting one small intervening space and should yield, at the lowest estimate, one hundred and fifty million oysters.

The Modragam yielded 12,000,000 of oysters at the fisheries of 1859 and 1860. The ground now covered is much larger, being over a mile square, and more abundantly stocked, and should therefore now fish some twenty millions. Thus, my estimate of the present condition of these two banks is one hundred and seventy millions of oysters. Of course, before they can be fished, natural decay will materially reduce this quantity; but comparing their extent and stock with 1855 and 1860, I see every ground for believing, unless circumstances not now fairly to be anticipated should prevent it, that

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the Cheval and Modragam will yield within the next five years one hundred millions of oysters, and at least £200,000; and I entertain the opinion that if these banks are judiciously fished, they will be yearly replenished by the mature oysters, and the present series may be continued (with intervals of one and two years only) without the long lapses which have hitherto occurred.

The present brood of oysters are no doubt the produce of the mature oysters of 1855 and 1857, as at the fishery of 1857 the coir cable of the guard vessel at anchor outside the then fishing ground was found to be covered with very young oysters. Seeing this future promise, I required the boats to be strictly kept to the actual fishing ground, to be most careful in their proceedings, taking only mature oysters, and throwing back all young ones, and subjected boats disobeying orders, and bringing on shore young oysters, to loss of their day's fish and future employment; and in 1859 I only used 50 boats per day and occupied 11 days in fishing the remnant left on the bank. 100 or 150 boats would have swept the ground clear in four or five days, but such a number of boats being less under control, would necessarily have trespassed beyond the narrow limits of the real fishing ground, and disturbed, perhaps destroyed, young oysters.

Fish, snakes, and chanks destroy an enormous number of young oysters. Current and drifts of sand carry away into deep water or cover beds of oysters, but in my opinion the frequent lapse of fisheries may be mainly attributed to the system under which, years ago, the banks were fished, namely the *renting* to one or two persons the right of fishing with from 100 to 300 boats daily, with no control over the proceedings of the renter and divers, but that of restriction to certain limits and the hours of fishery. So large a number of boats were of course beyond control, and not only may they have fished beyond the proper limits of the bank, but there was no means of knowing either the quantity or quality of the oysters fished, matters that should be carefully watched and recorded as a possible means of regulating and ensuring more continuous fisheries. 100 boats a day should, in my opinion, be the maximum of any fishery, as the control of all proceedings connected with this number can be maintained. Of course, circumstances may arise in connection with a special bank that might necessitate the occasional increase of this number: but as a general rule, I consider the fishing with any larger number of boats unadvisable.

The renting of fisheries had, besides the special one to which I have alluded, many other disadvantages in the character of its monopoly, its interference with the fair legitimate earnings of the divers and boatmen, the constant disputes with the officers, the assertion of losses, the claims for remission, and the impossibility of ever satisfactorily determining them. These, and the inability of ascertaining correct, I may say, any data of the results of fisheries so conducted, induce me to express the hope, that however large a sum may be offered for the renting of a fishery, Government will not accept it. The sum offered may exceed all expectations, and possibly what may be actually realized by two or three fisheries; but I am certain the results would be detrimental to future fisheries. I may also quote the opinion expressed in 1854 by Mr. Dyke, in reporting upon an offer to rent the fishery of 1855:—

"My opinion remains unchanged. It seems to me that Government could not ever derive any peculiar advantage from the plan of renting; that it must frequently lose much by it; that the proceedings of 1835, 1836, and 1837, [1855 to 1860 may now be added] have established that fisheries can be successfully conducted without having recourse to renting, and that by the sale of the oysters, the fair value of a fishery is realized in a straightforward manner, devoid of all mystery, deception, and concealment, as purchasers have to a great extent the means of ascertaining the real value."

The renting system is the much desired object of the rich chetties, who, I believe, would now make a large pecuniary sacrifice for its re-introduction;

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and this was the real purport of their combinations and proceedings at the fisheries of 1857 and 1858.

There is one special subject in connection with the Pearl Banks, which I think deserves consideration and trial, and which had the opportunity offered during my term of office, I should have given, viz., the removal or transplanting of beds of young oysters to the evidently more protected and favoured grounds of the Cheval and Modragam Paars. That this may be done without injury to the pearl oyster, I am satisfied from the proof I have had of its tenacity of life. The practice of transplanting the edible oysters to more favoured localities is very common in England, and has of late years been most extensively and successfully carried out by the French Government in the formation of oyster grounds along different parts of the French Coasts. As an experiment, and as the most likely means of saving the oysters from the causes which have hitherto so generally befallen all other broods but those found in the Cheval and Modragam, it is worth the trial, and should be attempted on the first favourable occasion that offers, of a healthy bed, say of one or two years old, sufficiently near to the Cheval or Modragam, to allow of their being taken up and re-deposited the same day in water. A sufficient quantity should be left on the original ground to test their progress with those removed.

I do not entertain the opinion generally expressed as to the Pearl Banks being robbed, and the necessity for a steamer constantly to guard them. The majority of the banks are distant from 8 to 12 miles from shore, and the land-marks by which their positions are ascertained cannot be seen from small boats; and if robberies had really been affected either by parties of Ceylon or the Coast of India, rumour would certainly have afforded actual proof, as oysters can neither be removed nor opened in a concealed manner, and the display for sale of quantities of pearls by the class of persons thus having them would have led to detection. No proof of robbery has ever been asserted or afforded; but because it is supposed to be easy of accomplishment, which I do not admit, the supposition has been received as a fact. I believe the fishermen who fish along the N. W. Coast during the N. E. monsoon do much harm to some of the banks by the use of large drag nets. This sort of fishery within the precincts of the Pearl Banks is illegal, and a party lately arrested whilst so fishing, by Mr. Worsley the Supervisor, having been punished, will, with frequent inspection of their boats and nets by the Supervisor, check such proceedings; but an amendment of the law is necessary, and also an efficient guard during the N. E. monsoon; and I consider this service can be well performed by the Schooner "Ceylon" lately obtained from England, and the former guard-boat. During the S. W. monsoon the Arippo Coast is a dangerous lee-shore, near to which no vessel will venture, and nature is thus a most effectual guardian of the Pearl Banks during many months of the year. A steamer's movements might be quicker, but she cannot, as the two guard boats may keep watch upon two points of the Coast at the same time, nor could she overtake a fishing canoe; she could bring her to, with a gun, or run her ashore, both of which the boats can do, and the latter more effectually.

The favourable season for this work is the N. E. monsoon more particularly the month of March, and whenever there is no Pearl Fishery, the whole coast between Negombo and Manaar should again, as in 1862, be examined to see if the small bed of young oysters then found off Negombo is alive and increasing, or if the banks off Chilaw, Calpentyn, and Karativo give any promise. This service might be done in the fine weather of January and February by Mr. Worsley with the schooner and the English and Native divers. Owing to the fisheries of the last five years occupying the fine weather of February to April, inspections have of necessity taken place between the end of October and middle of November in the lull of weather

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between the monsoons; but the period is too short and too precarious for any proper inspection, and only fitted for the examination of a known bed of oysters, and the taking of a sample to test their condition, and determine when they should be fished. In 1857 I was kept by strong S. W. winds at anchor off Sillawatorre for 12 days, and during some 25 days of absence on this duty, there were only five workable, whilst in 1858 there were 18 days of such fine weather as to allow of the examination of the coast from Arippo to Tallamannar; but in 1861 there was only time to take up a sample from the Cheval Paar, a gale of wind nearly wrecking the "Pearl," indeed, but for steam power allowing her to get off the land and out to sea, such would have been the case.

It is in the work of inspections that a steamer is so necessary and useful, affording as this power does quickness and precision of movement in placing vessel and boats in the exact positions needed—a matter often unattainable by sailing craft—and now that in lieu of the heavy unmanageable native boats, the fishery establishment has boats of English build, easily pulled and towed, the work is capable of being done with greater celerity and correctness. With a steamer the Superintendent has the means of satisfying *himself* of the extent and condition of all parts of a bed of oysters, by running all over the ground buoyed off, upon which the Inspector and inspection boats may be at work, and sending down the English and Native divers. With the former he can, in light weather, by letting the vessel only drift, have the ground thoroughly examined. In March 1862 I had the diver down for above an hour at a stretch, and walking over from one to two miles of ground, thus checking entirely the reports and proceedings of the inspection party.

The proceedings of inspections are thus conducted:—The Inspector with 6 boats, each having two divers and buoys in charge of a coxswain, leave the vessel at daylight, when the sea is always calm in the N. E. monsoon, spreading themselves to the four points of the compass, and diving continually in any depth of water not exceeding 8 to 9 fathoms. If rock is found one flag is hoisted. This attracts attention, as oysters are more generally found on such ground. If oysters are found, two flags are hoisted, and a buoy is at once laid down; the other boats then work their way to this point, noting if the ground be rocky, taking down such flags when getting only on sand and placing buoys if oysters are found. The limits N. S. E. and W. are then ascertained, the Superintendent in the steamer re-examining and going all round and beyond the buoys. The age, condition, and quantity of the oysters being satisfactorily ascertained, the Inspector then lays down the exact position of the bed by the bearings of the land-marks, the most prominent on the Arippo Coast being Kodremalle Hill, Kallar Beacon, Modragam trees, and the Doric; the two former being the most generally seen and to be relied on. Taking also the bearings of each buoy, he ascertains the extent of the bed, and lays it down on the Chart; according to the number of oysters a diver is able to bring up at a time (and the coxswain keep these particulars for the portion of the bed they work upon) the calculation is made of how many five divers with relief, constantly at work for 6 hours a day, could bring up, and the probable quantity of oysters on the bed and its out-turn is thus assumed. Of course, this estimate is always very much below the actual out-turn at a fishery, but the aid which the English diving system, employed since 1859, affords in inspections by the ability of remaining longer under water exploring the bed of the ocean, and giving more precise and explanatory account of the extent, quantity, and conditions of beds, not only tends to allow of more correct estimates on these points, but is a great and needed check upon the native divers, whose information could not always be depended upon, because, from the short time they remain under water (at most a minute a spell) their observation was very cursory, and it was believed they had reasons for not telling all they did ascertain.

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When a bed of oysters is of an age to be fished, a sample of 10,000 or 12,000 is taken up, landed at once, and being most carefully counted, are placed in a large ballam or boat. The place of deposit is then secured and guarded; after 10 or 12 days, when the oyster flesh has become a mass of putrid matter, the washing takes place; sea water is then put into the ballam, and a number of coolies divested of all clothing that would allow of concealment, are ranged on each side of the ballam, watched by the peons to see that they keep their hands under water when separating and washing the oyster shell, and do not take and conceal any of the Pearls they may see or feel. The shells are well rubbed together, those having pearls adhering thereto are set apart for the pearl to be cut out away, and the other shells are placed in heaps alongside each man, and when all is completed are counted, to see that none have been taken, and to ensure the correctness of the quantity upon which the estimated value of the fishery is thus based. After all the shells are removed, the water is baled out and passed through sieves and cloth to arrest any pearls that might be so taken up, and then a disgusting mass of filthy putrid matter and mud remains, amongst which you see the pearl glistening, and the excitement of looking for and collecting the large ones begins. The Superintendent's eyes must be everywhere to prevent any hands but his own picking them out, for the natives are most quick-sighted and equally quick-fingered. The mass of mud, sand, shells and putrid flesh is then collected in a heap at one end of the ballam, and after being cleansed by repeated washing, is laid upon cloths exposed to the sun to dry; when thoroughly dry the large pearls are picked out by hand, and the smaller ones sifted by women. During this process, every precaution is taken that no pearls are lost; every article used is washed, and the water passed through sieves of the smallest size, and a vigilant watch kept over all the people employed, as they are adepts at seeing and concealing pearls.

When all the pearls are collected, three or four intelligent, respectable pearl dealers, who are mostly of the Moorman class, are called in to estimate their value, which is done by sizing, classing, weighing; and according to these results the valuation is assigned to each class of pearls by the market rates then ruling. I shall briefly describe these operations which occupy a long time, and needing great judgment, are causes of much discussion and frequent difference of opinion; to settle which, the dumb alphabet is frequently used under a cloth to let the Senior or accountant of the party know and decide by such individual opinion. Each of the four has his duties, one sifts, another classes, the third weighs and the other records these results in manner shewn in the valuation paper, annexure No. 3.

Sizing or arranging the pearls into 10 different sizes from the largest to the smallest, is done by passing them successively through what are called baskets, *i. e.*, small brass sieves, said to be of 20, 30, 50, 80, 100, 200, 400, 600, 800, 1,000 holes each, though there is no certainty that all baskets really contain these exact numbers except the larger ones. All pearls are first sifted in the 20 baskets, and those retained by it are of the largest or 1st size, then those retained by the 30 are of the 2nd size, and so on, through the whole 10, and those that pass through the last size are what is called "Massie Thool," small like powder or dust. There are also shell pearls, excrescences cut from the oyster shell which are of various sizes and shapes, and not generally passed through the sieves, in fact they are mainly included in the sample, to show that all its out-turn of character, bad as well as good, is fairly exhibited for the information and consideration of the dealers and speculators.

It will be understood that each of the 10 sizes may include those of nearly every class; the 20 to 80 baskets may each have Anie, Anatharie, Kallippoo, Korowel: and this necessitates the second operation of classing—one that requires the greatest skill and judgment, and which hardly any

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two persons will do alike. The perfections in pearls are shape and lustre, viz., sphericity, and a silvery brightness free from any discoloration whatever; and, as the pearl has these two essentials, so do the valuers assign them to their appropriate class, namely:

Anie—perfect in sphericity and lustre.

Anatharie—follower or companion, but failing somewhat in one point, either sphericity or lustre.

Masengoe—confused, imperfect, failing in both points, especially in brilliancy of colour.

Kallippo—rejected or outcast, as failing still more in both points.

Korowel—nearer or shorter a double pearl.

Peesal—mis-shapen and clustered more than two to each other.

Oadwoe—beauty.

Mandangoe—folded or bent pearls.

Kural—very mis-shapen, small.

Thool—small grains.

The pearls having been sized and classed, each class is then weighed and recorded in Kalanjie and Manjadie. The former is a brass weight, equal, it is said, to 67 grains; the manjadie is a small red berry, having the property when full sized of being all exactly of the same weight, and are reckoned as 20 to the kalanjie.

The weights being ascertained, the valuation is then fixed to each pearl or set of pearls, according to their respective sizes and classes, the inferior classes solely according to weight at market value of such pearl at so many star pagodas, *i. e.* 3½ rupees each per kalanjie; but the superior classes, *i. e.* Anie, Anatharie, and the Vadivoe, if good, are not valued only by weight. but at so much per chew of their weight, the native pearl dealers' method of assigning the proper value by weight to a valuable article of small weight; and is, I apprehend, akin to the practice of dealers in precious stones who multiply the value per carat by the square of the weight of the article; this is rather a meagre explanation of the chew, but a fuller one would need illustration by figures.

When a fishery is to take place, notice is issued in the Government *Gazette* according to the Form Annexure No. 3 and about the middle of February the bank to be fished is buoyed off, and a sample taken up and valued so that its out-turn may be compared with that of November, and the latest condition and prospects exhibited; it is this sample, always very much superior in weight and quality, by which the speculators are (until they have washed the purchases) guided. By the end of February, Sillawatorre,—an arid, desolate sea-coast village scarcely inhabited, but so situated as to be the exact position from which the fishery boats can daily go to and from the banks, and containing space sufficient to accomodate without interference with private rights all the needs of a fishery, and too far distant from any place for its results to be the cause of annoyance to any but those whose duties or inclinations bring them there,—is densely thronged with thousands of natives of all classes, traders, pearl merchants, divers, boatowners, boatmen, and coolies, besides visitors, English and Native whom curiosity may bring to see what may be fairly called a most interesting sight and a wonderful Eastern fair. Then there are the Government establishments, a few troops to guard the Treasure and prevent any raid that might be attempted upon the thousands of money and property brought to the fishery; a medical establishment, and a body of Police to keep order, and, if possible health amongst this mottley assemblage of European, Tamil, Singhalese, Moormen, and the still more varied tribe of the Chetty class and caste, that flock from all parts of Ceylon and India. The largest number of arrivals take place from the 25th February, and I have noted as many as 30 to 50 boats a day coming in with the sea-breeze, in companies of 5 or 6,

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all fully laden with men, women, and children, and the materials for their hut; and as they passed "the Doric," the Superintendent's residence, they would give a Yo, Ho! cheer of gratification and satisfaction as the termination of the voyage, and perhaps of recognition of their Dorie for the time being. It is wonderful, considering the long distance they come from the continent of India in open Boats and laden as they are, that no loss of life occur, or at least is heard of. By the end of Eebruary the barren sandy beach of Sillawatorre is filled with some 5,000 or 6,000 persons who have housed themselves in temporary cadjan buildings of all sorts of character, according to the means or caste of the residents. Kootto sites for the deposit and decomposition of the oysters bought at the public sales, are marked out and awarded to intending speculators; these places are placed far to the south and beyond the inhabited ground, which is to the northward; and as the prevailing winds are from the northward and eastward, the stench of the decaying oysters is carried away from all but the parties employed at the koottos, guarding, receiving and washing; but an occasional burst of strong southerly wind of course disperses the aroma over every part of the inhabited quarter. With this come flies innumerable (indeed these are incessant and trying plagues, though worse with the southerly winds), everything, especially of eating and drinking, is covered with a black mass,—a glass of wine or water must be instantly drunk, or it is filled with them, and during this time the worst city perfumes are slight in comparison to those of the fishery; but this does not last long; and indeed it seems providentially so arranged, that the prevailing winds should aid the needs and purposes of the fishery; the land wind is fair and gentle to carry the fishing boats out to the banks, also the effluvia from the oysters from the land out to sea, thus giving to the inhabitants a somewhat sweetened period for rest; then, as the sea breeze is from the northward, it brings the boats quickly from the banks to the shore, and carries the oyster smell away from Sillawatorre.

As the boats arrive they are registered, and after the day fixed for closing the list they are examined as to size, condition, and fittings. Some are rejected as too small or badly found, but as the residue is always double the number needed, the fortunate privilege of being engaged in a fishery is determined by lottery. Selection would be difficult, certainly unlikely to give satisfaction, and would lead to other consequences, whilst the result of the lottery is borne as the consequence of fate or ill-luck. As this lottery is the first great, I may say, momentous event of the fishery, as the interests of 1,500 to 2,000 persons are concerned, the divers as well as the boat-owners and boatmen, being generally interested in particular boats, I will briefly describe the proceedings. Say that 50 boats are required, and that there are 75 from various places on the Continent of India and Ceylon, the prizes would be regulated and calculated as near as possible to the proportion, and with the desire that boats from each place shall have employment; then, say there were

Killacarre boats	14,	about equal to	1-5th	of the 75, the prize would be		9
Tallamanaar ,,	13,	do.	1-6th		do.	9
Navantorre ,,	14,	do.	1-5th		do.	9
Calpentyn ,,	6,	do.	1-12th		do.	4
Paumben ,,	5,	do.	1-25th		do.	2
Manaar ,,	1,	do.	...	...	...	1

and so on. On the day of the lottery, the Kachcheri grounds are crowded with many hundreds of persons to witness the proceedings, to wish good luck to their friends, and laugh at those who are unfortunate. The Superintendent calling any set of boatmen, counts the number of blank and price tickets into a bowl, and the tindals, shewing their register tickets, come forward to draw. The agitation, anxiety and eagerness of all are depicted in the countenance; most utter an apparent prayer or invocation, the Catholics cross themselves

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and many are almost too nervous to pick up the paper; when done, it is handed to the Superintendent, who opens and declares blank or prize; and so eagerly do they watch the glance of the Superintendent at the paper, and so quick-sighted are they, that I have recognised the disappointment or joy before I gave utterance to the result. If successful they run off dancing, and are greeted by their friends; if not, they move away slowly amidst the jeers and laughter of the by-standers. The unsuccessful are however frequently afterwards employed; some get the places of boats misbehaving, and if the extra number of boats is large, two divisions of boats are employed. Indeed, as they come from very long distances, and embark all their means in this speculation, I have always made the effort to find employment for all before the fishery closes; but those successful at the lottery have, of course, the first claim, and the good fortune of longer employ.

The crew of a boat consists of 23 persons, and is required and allowed only to have 5 diving stones; 1 tindal or steersman; 1 saman oattee who has charge of the boat; 1 thody who bales out water and cleans the boat; 10 divers, 2 for each stone; 10 munducks or divers' attendants to pull up the stone and oysters, and aid the divers.

Their remuneration for fishing up the oysters is one-fourth* of the quantity daily fished; this system and compact ensures to the Government the certainty of every possible exertion on the part of each boat, such being to their own advantage, and avoids all the consequences that might arise, if the boats were remunerated by daily pay. Indeed it is the speculative character of each day's work that induces the great exertions, and gives to all concerned the personal interest so necessary to carry on the hard and anxious work of a pearl fishery. Each boat's share is divided amongst themselves, according to old established customs, in the proportions noted in Annexures Nos. 4 and 5, which papers give the general regulations enforced at the fisheries.

The fishery is actually commenced on the first night of the boats going out to the banks, and of course creates great interest and excitement. If the night be moonlight, and if possible I have always selected such, thousands of people assemble on the beach to see the start, and give their good wishes. At about 10 o'clock, the tindals who carry on their right arm a ticket No. corresponding with that painted on the bows of each boat, assemble with crews around them, and as the Beach Master has checked each crew, they go to their boat and make the preparations of getting under weigh and into position, ready to hoist the sails and start directly the signal is given. At 12 o'clock the gun is fired, the Adappenar, the senior headman, hoists a light at the masthead and leads off. In a few minutes all the boats (on occasions above 100) are under press of sail, and the sight is indeed a very interesting and exciting one: the crews of the boats cheer, and the people on beach echo them; and the white sails following the signal light of the Adappenar's boat may be distinguished for miles out at sea. The Inspector's guard vessel anchored close to the fishery ground has a light at the maintop-mast head, and in dark nights blue lights are occasionally burned to see her position. The boats reach the bank, distant, the Cheval Paar about 12, and the Modragam about 9 miles, generally about 3 or 4 in the morning, and anchor; at 6 a.m. a gun is fired by the Inspector, as the signal for the boats to get under weigh and follow the Inspector and headmen to the fishery ground allotted for each day's work. When in position, and as the sun rises and the day gets calmer and hotter, the busy hum of 2,000 to 3,000 persons hard at work is heard. As I have before noted, each boat is furnished with 5 diving stones, 3 are worked on one side, 2 on the other, suspended by a thick rope over sticks or outriggers projecting from the boat's sides in such a convenient position as to allow the diver, whilst at the surface of the water, to adjust the stone by lowering or raising it, when he rests his foot upon, or rather within

* This was increased in 1881 to one-third.—COMPILERS.

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a loop affixed to it; these stones are generally about 14 lb. weight, and are used to accelerate the descent; and I have seen a very celebrated but corpulent and therefore buoyant diver carrying an additional stone affixed to his waist. He then places the loop of his diving net around his neck, and being thus ready gives notice to the two munducks, the attendants in charge of the rope and line of stone and net, draws in his breath, closes his nostrils with one hand, raises his body to give force to the descent, slips his hold of the bight of the diving cord, and is rapidly carried to the bottom; reaching the bottom he leaves the stone (which the munducks instantly haul up and make fast), throws himself on the ground, along which he creeps filling his net as quickly as possible; when obliged to ascend, he jerks the *net* cord, which is instantly hauled up by the munducks, by which time the diver is also at the surface, and again holding on by the diving stone; the diving is then repeated by the first set until their number of turns is over, when they take rest and the second five divers and munducks do the work; thus, under the excitement of expected gain, these men continue for 6 hours without flagging at this most trying and laborious exertion. When regularly at work they remain under water from 60 to 70 seconds. I have timed them 75, 80, 85, and one man 95 seconds; but I believe this to be a special, as it was the only instance I ever witnessed of a diver remaining so long under water, and that the working period is about a minute. Of course the number of oysters brought up at each dive depends upon the quantities on the ground. I have known as many as 80, but 40 to 50 is a good average; and this would give from 20,000 to 30,000 as a boat-load. At the fishery of 1857, when the daily fishing was from 1 to 1½ million oysters, many boats brought 30,000, a few 40,000 a day, and some boats not half the former quantity, and if this is shewn to be the consequence of bad divers they are discontinued. At 12 or 1 o'clock, according as the sea breeze sets in and to the work done, the Inspector fires the gun to leave off diving and set sail for Silavaturai. Soon every boat is under sail, all racing to be first in, to which is attached not only a recorded distinction which gives consideration for employment during extra days, but those also first in get sooner possession of their share of their oysters and obtain the best prices. Between 3 and 4 the boats reach the shore and discharge their load of oysters into the Government kootto, a large enclosed place within which is marked spaces bearing each boat's number. Each boat's fish is arranged into 6 separate lots, and each lot divided into 4 smaller lots, the Government officers giving over to the boatmen one of each 4 divisions, in all 6 parcels; and as the people do not know which of the 4 is likely to be assigned to them, they very carefully and fairly divide them; the other 3 of each of the 6 lots are then thrown together, counted, and removed to the sale and delivering portion of the kootto, and the boat's number affixed to each heap. By the next morning a return is furnished to the Superintendent of the separate out-turn of each boat, and the total of the preceding day's fishing. A sale is held at the Kachcheri about 12 o'clock, when the oysters are put up in lots of 1,000 with the right of taking at the price knocked down from 1,000 to 20,000 or 30,000. According to the total quantity for sale, (which is always declared at the commencement), and when there is no combination, purchases are eagerly made at the larger quantities; but when there is either a combination to lower prices, or opposition between the Chetties and Moormen, the sales are prolonged by lots of 1,000 to 2,000, and all the ingenuity of each party exercised to effect the object in view. As soon as the purchasers pay for their lots, delivery orders are issued to the officers in charge of the kootto, and until the fishery boats arrive, the oysters are delivered. This goes on daily, and from the first day of fishery until the conclusion, the work is incessant. A break occasionally occurs from a southerly gale or combination practises; sometimes the sea breeze coming in strong and not fair, drives the boats to leeward of Silavaturai, and obliges them to pole for miles along shore; and they do not get in till late at night, perhaps are dropping in all night until morning. On such occasions

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the shore is lighted up for miles with chools to guide the boats, and guards are set to prevent the crews landing the oysters, and all the establishments are of course obliged to be in attendance. In 1857, the large quantities daily fished, and the combination on the part of the buyers, so retarded the sales, that I have been frequently kept at this work until 10 at night; indeed there are no regular hours of work, all must attend as the need requires; the occupation is incessant and laborious, and only kept up by the excitement of each day's proceedings.

Annexure No. 3. (Corrected to 1881).

GOVERNMENT ADVERTISEMENT.

Notice is hereby given that a Pearl Fishery will take place at Silavaturai in the island of Ceylon, on or about the 20th of February, 1881, and that the bank to be fished is the north-west Cheval, estimated to contain oysters sufficient to employ 100 boats for thirty days, with average loads of 10,000 oysters each per day.

It is therefore recommended that such boat owners and divers as may wish to be employed at the said fishery should be at Silavaturai on or before the 15th February next, and it is notified that the first day's fishery will take place on or about the 20th of Febrnary, weather permitting.

The fishery will be conducted on account of Government, and the oysters put up to sale in such lots as may be deemed expedient.

The arrangements of the fishery will be the same as have been usual on similar occasions.

All payments to be made in ready money in Ceylon currency.

Drafts on the Banks in Colombo or Bills on the Agents of this Government in India at ten days' sight will be taken on letters of credit being produced to warrant the drawing of such Drafts or Bills.

For the convenience of purchasers, the Treasurer at Colombo, and the different Government Agents of Provinces will be authorized to receive cash deposits from parties intending to become purchasers, and receipts of these officers will be taken in payment of any sums due on account of the fishery.

No deposit will be received for a less sum than five hundred rupees.

By His Excellency's Command,

J. DOUGLAS,
Colonial Secretary.

Colonial Secretary's Office,
Colombo, 9th December, 1880.

Statement of the valuation and produce of 16,200 oysters taken from the N.-W. Cheval in November 1880.

No.	Description.	Size in basket.	Number.	Quantity in Chevoe.	Kalangey.	Manjady.	Total. Kalangey.	Total. Manjady.	Value.	Total value.	Per Chevoe. (Star Pagodas.)	Per Kalangey. (Star Pagodas.)
									R. c.	R. c.		
1	Peesel ...	20	4	—	—	1 1/2	—	—	0 39	—	—	1½
2	Kodai ...	—	7	—	—	3	—	4 1/2	0 52½	0 91½	—	1
3	Anatharey	30	3	1/4	—	1	—	—	8 75	—	10	
4	Kalippu ...	—	4	70/320	—	1 2/16	—	2 2/16	3 82½	12 57½	5	
5	Anie ...	50	2	16/320	—	6/16	—	—	3 50	—	20	
6	Anatharey	—	3	27/320	-	10/16	—	—	3 54	—	12	20
7	Kalippu ...	—	11	—	—	2 10/16	—	—	9 19	—	—	14
8	Koroval ...	—	12	—	—	3 6/16	—	—	8 27	—	—	4
9	Peesel ...	—	17	—	—	4 1/4	—	—	2 97½	—	—	
10	Kodai ...	—	5	—	—	1 1/4	—	12 1/2	0 5	27 52½		
11	Anie ...	80	6	45/320	—	1 1/16	—	—	11 31	—	23	
12	Anatharey	—	5	27/320	—	3/4	—	—	3 54	—	12	
13	Kalippu ...	—	12	—	—	1 11/16	—	—	4 72	—	—	16
14	Koroval ...	—	12	—	—	1 3/4	—	—	3 6	—	—	10

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No.	Description.	Size in basket.	Number.	Quantity in Chevoe.	Kalangey.	Manjady.	Total. Kalan-gey.	Total. Man-jady.	Value.	Total value.	Per Chevoe.	Per Kalangey.
15	Peesel ...	—	9	—	—	1 10/16		—	0 85½	—	—	3
16	Kodai ...	—	5	—	—	3/4		7 10/16	0 5	23 54		
17	Vadivoe excluding Madanku.	100	—	2 197/320	1	8 3/4	4	8 10/16	210 50	210 50	15	
18		200	—	1 134/320	1	8 6/16						
19		400	—	312/320	1	11 1/2						
				4 3/320								
20	Tool	600										
21		800	—	—	5	7	5	7	56 17½	56 17½	—	3
22		1000										
23	Marsietool.	—	—	—	2	13 1/2	2	13 1/2	14 4	14 4	—	1½
24	Shell Pearls	—	—	—	—	12 1/2		12 1/2	1 0	1 0		
						Total....	14	8 6/16	34 27			

(Per Chevoe and Per Kalangey: Star Pagodas.)

JAMES DONNAN, Inspector of Pearl Banks,
M. SEEMANPILLAI, Mudaliyar, Adigar of Musali, &c.,
ச. இ. ச. மரக்காயர் கபீபுமுகம்மது.
(S. I. S. MARAKAR KABEBO MOHOMEDOE.) } Pearl Merchants.
அக. அந்தமது முகிட்யதீன்
க. சா. லெ. காதிர் சாகிவு.

Silavaturai, 29th November, 1880.

Annexnre No. 4.

NOTICE FOR THE GENERAL INFORMATION OF PERSONS ATTENDING THE FISHERY.

1.—Application for ground for dwelling houses, boutiques, and Kootto, to be made to the Assistant Agent of Manaar, who will grant a permit for the ground allotted: and any house or Kootto erected contrary to orders, or without permit, will be removed.

2.—The arrangements of Police, will be made by the Assistant Agent; and it is hereby notified for general information, that the Police Establishment is intended exclusively for the protection of all persons attending the Fishery, the maintenance of good order, and the preservation of the Public Peace, that they have no concern in the management of the Fishery, or in the collection of any dues, either for Government, for Temples, or any other account; and that such employment on their part is positively prohibited.

3.—The Police, and all Peons, will at all times wear their Belts and Badges. They are particularly required to be civil and gentle to all persons, and carefully to abstain from interfering with any person, except where it is necessary for the preservation of good order.

4.—No persons connected with the Establishment will be permitted to receive any present or perquisite whatever, or to engage in any manner in the speculations of the Fishery, on pain of immediate dismissal.

5.—The Boatmen, and divers and all persons in general, are to take notice that no one is authorized to make any deduction from their shares, on account of privilege or charity oysters. All contributions they choose to make for charitable purposes will therefore be perfectly voluntary; and in the case of divers delivering oysters into the Government Koottos, it will not be permitted, even with the consent of the divers, that such contributions should be received by any one inside the Koottos. The Shark Charmer* is remunerated by Government, and is not allowed, under any pretence whatever, to receive,

* The shark charmer has since been done away with.

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demand or exact oysters from the boatmen, divers, or other persons. Any violation of this rule should be immediately reported to the Superintendent.

6.—After they leave the Koottos, the divers will be at liberty to do as they please with their oysters, and if molested they should apply to the Police for protection.

7.—The fishing boats will be inspected, under the immediate supervision of the Superintendent, as to their sea-worthiness, condition of sails and oars, and complement of crew. The crew of each boat will consist of 23 persons, viz:—1 Samman Oattee, 1 Tindal, 1 Thody, 10 Divers, and 10 Munducks; and previous to the inspection of the boats, the Samman Oattee will be required to furnish a list containing the names of the above-noted persons. [Of recent years all boats that have come are employed and divided into one or two divisions to fish on alternate days.]

8.—From the boats found to be qualified, the number required will take their chance of employment by Lottery.

9.—The Tindals of the boats so selected will receive from the Kachcheri Certificates, and a copy of the Rules for the guidance of their conduct when at sea, and on shore. And it is specially notified for general information, that those regulations will be strictly enforced, and the wilful breach of them will be dealt with as therein provided for.

10.—The tindals of all the boats employed and unemployed are to attend to the orders of the Beach Master, particularly with respect to the places where their boats are to be kept, and the mode of securing them so as to prevent interruption to the passage of other boats to and fro, and of people along the beach. Neglect of these orders on their part will subject them to be excluded from employ. No canoes are to be hauled up on the beach, except at the place assigned for them.

11.—No huts of any description are to be erected upon the beach, either for the use of the crews of boats or canoes, without special permission.

12.—It will be required that the boat's third share of the oysters fished daily, be divided according to established customs, viz:—

Samman Oattee—the oysters brought up in two divings for each stone, *i.e.*, one diving for each diver.

Tindal	do.	do.
Thody	do.	do.
2 Divers, of	each stone	Two-thirds.
2 Munducks	do.	One-third.

Thodyvalle or boat-owner, the whole of the boat's share of oysters once in six days' fishing; but the share may be taken any day *after*, but not *prior* to the *3rd day's fishing*, that may be agreed upon. Arrangements with divers to pay them by wages instead of allowing them their share of oysters, according to the established customs, are expressly forbidden.

13.—It is particularly notified, that the first day's fishing will *possitively* take place on the first day in March that the weather may permit the boats to fish. It is, therefore, recommended to such boat-owners and divers, as may wish to be employed at the fishery, that they should be at Arippo, *on* or *before* the 20th February.

Annexure No. 5.

INSTRUCTIONS FOR THE TINDALS AND BOATMEN OF THE DIVING BOATS IN EMPLOY.

1—The boats will be numbered by the Beach Master, and all orders to the tindals, divers, and boatmen, respecting the boats to proceed to sea each night, and the banks to be fished on, will be communicated to them through the Beach Master, to whose orders they are to pay attention; and any wilful disobedience thereof, will subject them to discontinuance from employ.

2.—The signal to proceed to sea will be as usual,—a gun fired and beat of tom-tom.

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The Adappanaar will proceed ahead with a light, and all the boats are to follow him; and on no account to take any other course, but keep as close as possible to the headmen's boats. This is not done now, as the guard vessel on the bank shews a light which can be seen 6 miles off.

3.—The signal to commence diving will be as usual, ensign hoisted to the mast-head of the Government guard vessel. This signal will be made at half-past six in the morning, and no diving is to take place until it is made. The tindals are to keep their boats within the boundary of the buoys, and the place pointed out by the Inspector as the fishing ground for the day. Boats fishing beyond these limits will be discontinued from employ.

4.—The signal to cease diving, will be a gun fired from the same vessel or the hauling down of the ensign, when all diving is immediately to cease, and the boats to return to shore.

Difficulty having been heretofore experienced in enforcing proper attention to this signal, the boatmen are warned, that notice will be taken of the numbers of the boats in which diving is continued after the signal is made, a report of which will be made to the Superintendent, who will impose a fine on the boatmen for such disobedience, or if the offence be reported, discontinue the boat from employ.

5.—The boatmen are to pay strict attention to the orders of the Superintendent of the Koottos, and of the peons, and other officers, acting under him, in respect to the business of landing and counting the oysters.

6.—Upon proof of oysters having been opened in any boat, such boat will be immediately discontinued from employ, and none of the boatmen, or divers, that may have been in it, will be allowed to enter into any other boats.

The finding of knives, sticks, or other implements, for the opening of oysters, will subject the party on whom found, and the boat to which he belongs, to discontinuance from employ; and all knives or other implements whereby oysters may be opened, and three-fourths of all pearls found concealed on the persons of the boatmen, or in the boats, will be given to the finder or informer.

7.—The crew of each boat to consist of 1 Tindal, 1 Samman Oattee, 1 Thody, 10 Divers, and 10 Munducks; the division of the boat's $\frac{1}{3}$ share of the oysters fished daily, will be according to established customs.

Samman Oattee—the oysters brought up in two divings for each stone, *i.e.*, one diving for each diver.

Tindal	do.	do.
Thody	do.	do.
2 Divers, of each stone		$\frac{2}{3}$
2 Mundocks,	do	$\frac{1}{3}$

Thodyvalle or boat-owner, the whole of the boat's share of oysters once in six days' fishing, but the share may be taken any day *after*, but not *prior* to the *3rd day's* fishing, that may be agreed upon. Arrangements with divers to pay them by wages instead of allowing them their share of oysters, according to established custom, are expressly forbidden.

8.—Divers deserting from the boats in which they are engaged before the fishery is over,—tindals, and Samman Oattees extorting from the divers more than the share they are entitled to will be subject to punishment.

9.—The boats are not to leave without the permission of the Superintendent, and they are to give notice of their wish to do so to the Beach Master.

GOLD IN CEYLON.

(From the *Ceylon Observer*, June 10, 1881.)

We have received by the English mail the following Report from Mr. J. Macdonald Cameron on the specimens of Ceylon quartz submitted to him by us during his recent visit to Colombo. The finest sample of quartz we think, comes

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from Matale, either from Caterateine or Kinrara' estate. The Hog's-back tunnel reef is evidently well worth looking after:—

J. Ferguson, Esq.

Sir,—Agreeably to your request, I have much pleasure in stating for the information of those planters who sent specimens of the quartz outcrop, on their estates, to the *Observer* Office, for examination by me:—

1st. That of all the specimens examined, only two were fine quartz.

2nd. Only one contained pyritous material: the form of combination with which gold is most usually found associated.

3rd. The purest sample of quartz is the small and very white piece which you showed me—I don't remember from whose estate it came. The most promising one is that which I believe to have been taken from a quartz outcrop at a place known as the Hog's Back. This should be thoroughly examined as it may lead to satisfactory results. Were the estate mine I would certainly spend some money in testing the direction and extent of the reef or bed, as well as of the pyritous material.

4th. The general appearance of the quartz examined proved conclusively that the samples were not properly selected; but although with the two exceptions mentioned, I was compelled to condemn them, it by no means follows that more promising material does not exist on these estates. Samples should always be taken at the greatest possible depth; and in the absence of free gold, from that part of the reef or bed containing the greatest amount of pyritous material.

5th. In connexion with the foregoing remarks and in conclusion, I may state that a very promising sample of Ceylon quartz was shown me by Mr. Robertson of the Oriental Banking Corporation, which, if taken from a reef or bed of satisfactory dimensions, ought to be thoroughly examined; but the most satisfactory, most promising sample of all, was one shown me by Mr. W. Ferguson as belonging to the Government Agent of the Western Province. This sample, which is nothing more or less than pure gold nuggets, varying in size from that of a pin's head to that of a No. 4 shot, was taken from the bed of the river at Ratnapura some 14 years or so ago. This is however highly important for those of you who are interested in the future development of Ceylon to know that the precious metal exists at your doors, and I venture to suggest that what I have now said in regard to the Hog's Back outcrop, Mr. Robertson's sample, and last but not least, the Government Agent's should not be lost sight of.

I am &c.,

J. MACDONALD CAMERON,

F. C. S. and Fel. Inst. Chem.,

Late Assistant, Royal School of Mines, South Kensington, S. W.

Laboratory, 52, Lime St., London, E.C.

The specimens of gold were those belonging to Mr. Saunders already described by us as found near Ratnapura a short time ago, and which Mr. Brough Smyth declared to be very fine gold which had not travelled far from the matrix. We are glad to learn that a trial is now being made in Ambagamuwa to test quartz reefs at a sufficient depth, some 12 to 15 feet below the surface outcrop. A similar shaft should be sunk in a favourable spot in Dolosbage.

GOLD MINING IN SOUTHERN INDIA: PRACTICAL OBSERVATIONS.

Mr. C. Rowe writes from Devalah, Wynaad, to the *Mining Journal*:—

Whatever may be the ultimate result of gold mining in the Wynaad, there is certainly much that is instructive and interesting in this gold field. Unlike on the discovery of the precious metals in Australia and California, there is not the least appearance of a rush. It may be said to be essentially the capitalist's mining field. There are no working miners, prospectors on the outcrops, with an arrastra going to grind up the prill, or choice pieces, as would have been the case on the discovery of a gold field on the Pacific.

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Even the mining laws which the Government has enacted, ostensibly to promote a legitimate mining industry, to encourage the coming of that class which did so much to open up Australia and California, must have a contrary effect. To take up Government lands for mining purposes, the applicant is permitted to mark off 30 acres as a mining claim, with 100 acres as adjunct, for milling and other purposes, but on the latter only surface rights are granted. The real difficulty is in the quantity of labour to be employed. To retain such right the law says the employment of 5 men per acre, or on the 30 acres 150 hands.

Alluvial and outcrop mining, however, is hardly thought of; it is the working of the many quartz veins all are looking forward so anxiously for remunerative results. That there is gold here, that it is in the quartz matrix, and that there are large outcrops of quartz on which the leading mines are located anyone who has had the opportunity of passing over the district can testify. Quartz, however, is very widely distributed in the Wynaad. Gold, it is said, has been found in places at considerable distances apart, thus encouraging the expectation that the quartz embraced in an area of 1,000 or more square miles may prove sufficiently auriferous to pay. But the principal mines are not widely distributed. They may be said to be embraced in a zone of about 25 miles long and 4 miles wide, or per Fig. 1, they are bounded on the east by the Nilgiris, on the west by the Vellery Mulla mountain range, their relative positions sectionally and within such zone, being as indicated in the above engraving.

There is not much diversity in the geology of the Wynaad gold-field. The country rock is metamorphic—a hard dense gneiss, varying slightly in texture and composition, as may be expected. Intrusive rocks are the exception. In two or three places, notably at Hamsluck Waterfall, there are what appears to be trap-like rocks; but, not unfrequently, the exceptional appearance is, perhaps, due to the varying conditions at work during the original deposition of the sedimentary matter. But, as far as has yet been observed, there are no great faults passing through the district; no upheavals, bringing rocks of opposite composition in juxtaposition; near, and even in such dislocations of strata, the principal metaliferous mines of the United States and England are usually found. In fact, it is questionable if the Wynaad veins can be called true fissure veins. Certainly, they are not similar in general character to the veins usually wrought in the two named countries; but, because it is not like any other district one has been accustomed to, it would be obviously unwise to infer, without trial, it is of less value. The Wynaad district will perhaps be found peculiarly unique.

As shown in section, the principal mines are located on or near a hill, which, in nearly all cases where outcrops are exposed, the country rock is completely disintegrated; that which was to all appearance one hard gneiss has become as soft as chalk or clay. Even in this disintegrated rock, when drifted through, the strike and dip of the strata is plainly discernible though at times it is more confused, and in the drift-side concentric rings may be seen, perhaps implying a land side, and that boulders had been imbedded in the *debris*. Nor must it be inferred the whole hill has undergone disintegration. In the bed of every stream, and protruding out at various places, the hard-gneiss rock may be observed. In the section the shaded portion is intended to show what may probably be found to be disintegrated rock.

The veins not unfrequently slope down with the side of the hill, indeed, sometimes a vein is only a few feet in from the sloping surface of the hill-side, and it causes a considerable controversy with many, if the veins will really penetrate the hard dense gneiss rock. Actual mining, however, will prove this, and it is satisfactory to know that at least two companies have started deep levels, which, when driven, must prove in their cases if the veins really go to an infinite depth or not. But should the veins fail to penetrate

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the very hard rock, the small angle which they make with the horizon gives to a mine located on a hill-side a large working area. The secondary hills are not unfrequently from 200 to 500 ft. high. Taking a known case where the hill is 240 ft. vertically, with vein sloping all down the hill-side, at an angle of about 20° to horizon; in such an instance the working value of the vein, above the base of the hill is 1,200 ft., or practically the same as a mine 200 fathoms deep in depth. Indeed, with the leading mines it will not be a question of quartz, but what its auriferous value per ton may be.

Adverting further to the vein formation, there is certainly much that is puzzling; it is not unfrequent to find huge isolated boulders of auriferous quartz, but no vein *in situ*. In not one instance only, but in several, those experts of "light and leading" have written elaborate reports, defined the dip and strike of the supposed vein, given estimates of possible returns, when the most superficial mining would have proved the supposed outcrops to be simply two or three isolated boulders. But the question arises how those boulders got there? There must be some law regulating what has been so misleading and erratic; any experience which may tend to elucidate the problem can therefore not be out of place, especially when we consider the interests in many places at stake.

The dip and strike of the veins seem to bear no relation to the dip and strike of the country rock. There is not an uptilting of strata in proximity to the veins, nor are the veins encased between parallel beds of gneiss rock, but rather, so to speak, within foliating fractures, due perhaps to shrinkage and lateral pressure at all angles to the dip, and trailing along on top of the harder rock. In fact, the veins in some places bear a strong analogy to a hard, poor coal seam on the confines of the carboniferous rocks, rolling about in places, as with coal swelling out into large blocks, then, a few feet farther on, represented only by a tiny string of quartz, but in nearly all cases embedded in a soft felspathic sand. Geologically, it is not difficult to conceive the complete erosion of hills, even to forming the great valley between the two ranges of mountains, so that the quartz being thus liberated, and very hard, have resisted disintegration, and have gravitated to levels and distances some way from their original or *in situ* position; or the prolongation of veins have had the encasing softer rock washed away, the quartz being so much more durable, have resisted disintegration, and may be found scattered about at all lower levels.

An interesting feature are the old native workings. One sees a not dissimilar method to extract the gold to that employed by the ancient miners on the moors and dales of Yorkshire—those old workings which are said to have been wrought centuries ago to extract the lead and silver contained in the veins. Those northern miners, tradition says, worked the hill-side veins by directing large quantities of water to flow down over the out-cropping mineral, forming between the hard limestone rocks great grooves sometimes hundreds of feet in length, and fifty to more, feet in depth; or that they "hushed" the vein matrix out, the old workings being still called hushes.

In the Wynaad the natives seem also to have used the erosive power of water to mine, but the geologic conditions would not permit an identical method to that in the north. Perhaps a section through the Yellembully vein will illustrate.

About six to seven miles west of Devalah are situated very large native workings. The vein crops out on the hill-top. The appearances indicate the racing of water along the vein from the west—perhaps during the monsoon—and having had small drifts driven in under the vein (some are still to be seen) into the soft sandy ground beneath, a large portion of the up-cropping vein would be undermined when turning in the water, and properly directed against the pillars, the latter would ultimately wash away, and large masses of quartz would fall down the south hill-side, which latter has the appearances of an

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old burrow, so covered is it with ragged and broken pieces of quartz, stones of considerable weight to small pieces like pebbles, implying the whole to have been carefully examined. Near Devalah, on the Adelphi estate, nearly a similar system has been employed. The vein in the latter slopes down near the surface in a hollow of the hill-side. Here the natives seem also to have cut through the vein in the hollow, made holes through fractures in the vein and turned in water, for their old drifts and little shafts are still to be seen. Their most mining-like working, however, are on what is probably the dip side of this vein on the north-east side of this hollow over a small hill. It is at this latter point the deep shafts of the native workers are found. An engineer and myself went down one of those 70 feet deep shafts.

The natives seem to have understood the danger of taking out the vein at the shaft bottom. They lift it entire at this point, and drove off in the country ground, then cross-cutted to the vein again. We went into this drift and cross-cutted a small distance, but further progress was obstructed by fallen *debris*.

Another native working which has attracted considerable notice is that of the Skull Reef, and on the extension of which below another on working has been driven the often-quoted Wright's Level. The vein at these places is 12 to 15 ft. wide, and as the quartz is quite hard, the old workings have not wholly collapsed, so that one is able to see the magnitude of their mining operations.

Skull workings referred to are also not unlike those shown, being simply a hole cut through the vein. All along this outcrop small shafts are numerous, indicating in their way considerable mining having been wrought.

Still extensive native workings should be understood. When compared with the abandoned diggings of California they appear small; compared with the ancient workings of Cornwall or those found in the lead districts in the north of England, the Wynaad workings take only a minor place.

There are many peculiarities here to which but little thought is given in England or the United States, notably the labour and climatic influences. Although it is said cooly labour may be obtained in unlitmited quantities, there are times when its scarcity will act detrimentally to mining industry. It may, perhaps, be taken as an axiom that to mine successfully the labour and appliances must be efficient and constant. At the present, labour is very scarce and not to be obtained, it is said, for a few weeks yet. This exodus is said to be due to feasts and the unhealthy condition of the Wynaad; still, although many suffer from fever, European and native, there is a goodly sprinkling of both classes who have thus far suffered no inconvenience from climatic influences. It is, undoubtedly, a matter of considerable importance, and will require serious thought. Those mines which the newspapers say are about making immediate returns in gold must seriously feel the want of labour. Indeed it is a question if Chinese labour would not pay to introduce labour that would be constant for at least one, two, or even three years' contract. One harassing feature now is if a gang of coolies are taught to perform the work in hand, the week following their places have to be filled by another gang. Certainly this is a matter that will in time correct itself—relays of coolies are constantly coming and going—still when the stopping out the roofs of the drifts when large quantities of rock is being mined, it will be necessary to have such labour, both European and native, who understand their work. Appearances indicate that the ground will require being efficiently and securely timbered, or the heavy rains during a monsoon may result in serious consequences to mining development.

Devalah, Wynaad, April 20.

[The difficulty about a steady and constant supply of labour felt in the Wynaad curiously enough would not apply to Ceylon, and our climate is also a safe one.—COMPILERS.]

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GOLD IN THE KURUNEGALA DISTRICT.

Mudaliyar Jayetilleke of Kurunegala has forwarded to us some interesting specimens of quartz and plumbago streaked with auriferous-looking substances. He writes as follows:—

"I send you per train some quartz picked up from different places in the district. I believe the glittering stuff adhering to them is mica. I simply send these to you to ascertain if the quartz I am sending is of the proper sort wherein I am to search for the real thing. I have been guided by the piece of quartz with gold you gave me; and what is more, I have shewn it to hundreds of people here, without telling them where it was got from, and I hear a good many are going about searching for gold. I wish them success. 18th June 1881."

The streak of green glittering matter in the plumbago is copper, while the quartz is freely mixed with pyrites, but of a very promising character, and in one instance Mr. A. C. Dixon thinks it must be auriferous. One mode of distinguishing between iron pyrites and gold in quartz is the tarnished look which comes over the former, but a good lens is required to distinguish this clearly. Mr. Dixon has himself found the evidences of gold in the Kurunegala district, some miles along the Dambulla road. It is this gentleman's belief that the reef which crops out in the Dolosbage district runs along by Rambukkana through the Kurunegala district. Further exploration is required.

THE CEYLON PRESENT OF PEARLS TO THE PRINCESS ROYAL

(From the *Colombo Observer*, February 17th, 1859.)

Pakier Tamby's gold and jewelled box, surmounted by an elephant, is, after all, to form the main portion of the present to the Princess Royal. A pair of rich pearl bracelets is to be added. The old jeweller told us last evening that he looked more to the honour than to the profit of the transaction—intimating that he had parted with the box below its value. But then when the Queen and Princess ask "Who made this box.?" the reply will be "Pakier Tamby of Ceylon!—the same, whose workmanship, exhibited at Paris, received *honorable mention*." And so, he says, his old age will be crowned with honour.

ACKNOWLEDGMENT OF THE PRESENT.

(From the *Colombo Observer*, June 23rd.)

We have received the following for publication:—

The Governor has received the following most gracious Letter from Her Royal Highness, the Princess Frederick William of Prussia, and has much gratification in communicating Her Royal Highness's sentiments and thanks, to all who took part in the offering recently presented.

Pavilion, Kandy, June 20th, 1859.

BERLIN, May 11th, 1859.

SIR,—I am commanded to inform Your Excellency, that Her Royal Highness the Princess Frederic William of Prussia, Princess Royal of Great Britain and Ireland, has had great satisfaction in receiving the magnificent presents forwarded by you for her acceptance on behalf of the Colony of Ceylon. Being the work of native artists, Her Royal Highness highly admired them for their taste and richness, and they are to Her Royal Highness objects of the greatest interest and curiosity. But they have, and ever will have, the gratest value in the Princess's eyes as a token of the affection and attachment which prevail, not only among the British residents, but among the native population of your Island, towards the person of Her August Mother, and which are in such a kind manner extended to herself. Her

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Royal Highness feels truly touched by so gratifying an expression of the tie of sympathy connecting her with a distant possession of the British Crown, and I am to request Your Excellency to accept for yourself, and to convey to all those who have contributed to, and co-operated in the preparation of this offering, the warmest and most heartfelt thanks of Her Royal Highness. I am at the same time commanded to inform Your Excellency, that Her Royal Highnesss has worn the bracelets, which have been much admired, and has placed one casket on Her table, and sent the other to a jeweller's in this town. to be exhibited.

I have the honor to be, sir, Your Excellency's most obedient servant,

(Signed) E. De Stockmar,
Private Secretary to H. R. H.

To His Excellency, Sir Henry G. Ward, K. G. C. M. G., Governor of Ceylon.

"GOLD IN CEYLON."

REPORT ON QUARTZ REEF ON AMBLAKANDA ESTATE, DOLOSBAGE.

There are two prominent quartz reefs crossing this estate striking N. 20° W., and having a dip of from 70° to 80° to the W. This strike nearly coincides with the auriferous reefs of South India, the geological age of which is contemporaneous with the hill districts of Ceylon.

I traversed the principal reef from the Ingurugalla boundary to the opposite limit of the estate in the ravine near the store, as well as the greater portion of a parallel reef. I had a few blasts put in several places which were much weathered, in order to determine the nature of the quartz below, and eventually selected two places which I thought advisable to examine. The *one* was in the ravine near the store which had to be abandoned on account of water. Most attention has been paid to the main reef standing out prominently forming a ridge, about centrally situated on the estate. In this ridge a large cutting has been made across the reef which is over 20 feet broad to a depth of over 12 feet. As the pit deepens the quartz becomes more compact in texture, and contains iron pyrites as well as magnetite and limestone. It is also slightly chloritic, due to the presence of chlorite. In some parts it is laminated with hornblende and felspar, and veins of micaceous clay are met with. A large portion of the quartz is cavernous. Towards the centre of the reefs the quartz is very compact, and I think extends to a great depth.

I have selected specimens of the rock from time to time and tested the samples. Near the surface no trace of gold was evident, but deeper down I met with slight traces, and the samples last taken furnish slightly better results—not more however than 4 grains to the ton, which is a very small proportion.

I am inclined to think that on further examination of this reef in its *extension* which is considerable, and probably even in Amblakanda, that gold will be met with in much larger quantity. The reef is well defined for a long distance to the North and South, probably the same as that met with on Mount Jean.

The time occupied in blasting has been long, and the depth to which the pit has been carried has but barely reached the limit I intended. The work is now stopped on account of the rains.

Alexander Campbell Dixon,
F. C. S., B. Sc., Honors London University.

Colombo, 23rd June 1881.

[June 25th.—It is likely that Mr. W. Evans, a practical Gold Miner, will be engaged to follow up Mr. Dixon's exploration in Dolosbage and Ambagamuwa.—Compilers.]

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PEARL.

Pearl.—A peculiar product of certain marine and fresh water molluscs or shell fish. Most of the molluscous animals which are aquatic and reside in shells are provided with a fluid secretion with which they line their shells, and give to the otherwise harsh granular material, of which the shell is formed, a beautifully smooth surface, which prevents any unpleasant friction upon the extremely tender body of the animal. This secretion is evidently laid in extremely thin semi-transparent films, which, in consequence of such an arrangement, have generally a beautiful irridescence, and form in some species a sufficient thickness to be cut into useful and ornamental articles. The material itself in its hardened condition is called nacre by zoologists, and by dealers Mother-of-Pearl. Besides the pearly lining of the shells, detached and generally spherical or rounded portions of the nacre are often found on opening the shells, and there is great reason to suppose these are the result of accidental causes, such as the intrusion of a grain of sand or other substance, which, by irritating the tender body of the animal, obliges it in self-defence to cover the cause of offence, which it has is no power to remove; and as the secretion goes on regularly to supply the growth and wear of the shell, the included body constantly gets its share, and thereby continues to increase in size until it becomes a pearl. The Chinese avail themselves of the knowledge of this fact to compel one species of freshwater mussel, Unio Hyria, to produce pearls. In order to do this, they keep the Unios in tanks, and insert between the shell and the mantle of the animal either small leaden shot or little spherical pieces of mother-of-pearl. These are sure to receive regular coatings of the nacreous secretion; and after a time look like pearls formed under ordinary circumstances. These curious people also practice another trick upon these animals; they insert small images of the Buddha stamped out of metal, which soon become coated with the pearl secretion, and are cemented by it to the shells; to those ignorant of its origin, the phenomenon is a supernatural testimony to the truth of Buddhism. Examples of these curiosities are to be found in many of our museums.

A plan of making pearls was suggested to the Swedish Government by Linnæus. It consisted in boring a small hole through the shell of the river mussel, and inserting a grain of sand, so as to afford a nucleus for a pearl. The plan at first succeeded sufficiently well to prove its practicability, and he was rewarded by a sum of money (£450) but it failed as a profitable speculation, and was abandoned.

The exact nature of the secretion has never been satisfactorily determined; it is, however, ascertained that it is deposited in thin films; which overlie each other irregularly, and to this peculiar disposition of the plates, the beautiful irridescence of common pearls is attributed. This formation was a great puzzle to the ancients, amongst whom they were highly prized. Dioscorides and Pliny mention the belief that they were drops of dew or rain which fell into the shells when opened by the animals, and were then altered by some power of the animal into pearls. This opinion which, obtained all over the east, is thus charmingly alluded to by Moore:—

"And precious the tear as that rain from the sky,
Which turns into pearls as it falls in the sea."

The most famous pearls are those from the east; the coast of Ceylon, or Taprobane as it was called by the Greeks, having from the earliest times been the chief locality for pearl fishing. They are, however, obtained now of nearly the same quality in other parts of the world, as Panama in South America, St. Magarita in the West Indies, the Coromandel Coast, the shores of the Sulu Islands, the Bahrim Islands, and the islands of Karak and Corgs in the Persian Gulf. The pearls of the Bahrim fishery are said to be even finer than those of Ceylon, and they form an important part of the trade of Bassora. These, and indeed all the foreign pearls used in jewellery, are produced by the pearl oyster. The shells of the molluscs which yield the Ceylon, Indian and Persian ones, are sometimes as much as a foot in diameter, and are usually about nine inches. Those of the New World, although the shells are smaller and thicker, are believed to be the same species. The chief locality of the Ceylon pearl fishery is a bank about 20 miles long, 10 or 12 miles from shore, opposite to the villages of Condatchy and Arippo on the northern coast. The season of the fishery lasts about three months, commencing at the beginning of February, and is carried on under Government regulations. The boats employed are open, and vary in size from 10 to 15 tons burden; they put out at night,

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usually at 10 o'clock, on a signal gun being fired from the fort of Arippo, and make for the Government guard vessel, which is moored on the bank, and serves the double purpose of a guard and a lighter-ship. The divers are under the direction of a manager, who is called the Adapanaar, and they are chiefly Tamils and Moors from India. For each diver there is provided a diving stone, weighing about 30 pounds, which is fastened to the end of a rope long enough to reach the bottom, and having a loop made for the man's foot; and in addition to this, a large network basket, in which to place the pearl oyesters as he collects them. These are hung over the sides of the boat; and the diver placing his foot in the loop attached to the stone, liberates the coils of the rope, and with his net basket rapidly decends to the bottom.

To each boat there is usually allotted a crew of 13 men and 10 divers, 5 of whom are descending whilst the others are resting. This work is done very rapidly; for, notwithstanding the stories to the contrary, the best divers cannot remain longer than 80 seconds below, and few are able to exceed 60. The greatest depth they descend is 13 fathoms. When the driver gives the signal by pulling the rope, he is quickly hauled up with his net and its contents. Accidents rarely happen; and as the men are very superstitious, their safety attributed to the incantations of their shark-charmers, performed at the commencement of the fishing. Sir E. Tennent, however, attributes the rarity of accidents from sharks, usually so abundant in tropical seas, to the bustle and to the excitement of the waters during the fishery frightening away the dreaded creatures. The divers are sometimes paid fixed wages: others agree for one-fourth of the produce. When a boat-load of oysters has been obtained, it returns to shore, and the cargo, sometimes amounting to 20,000 or 30,000 is landed and piled on the shore to die and putrefy, in order that the pearls may be easily found. The heaps are formed in small walled compartments, the wall surrounding each being about one or two feet in height. Several of these compartments surround a small central enclosure, in which is a bath, and they slope towards this bath, and are each connected with it by a small channel, so that any pearls washed out from the putrefying mass by the rain may be carried into the bath. When the animals in the shell are sufficiently decomposed, the washing commences, and great care is taken to watch for the loose pearls, which are always by far the most valuable; the shells are then examined, and if any attached pearls are seen, they are handed over to the clippers who, with pinchers or hammer, skilfully remove them Such pearls are used only for setting; whilst the former, being usually quite round. are drilled and strung and can be used for beads, &c. The workmen who are employed, to drill the pearls, also round the irregular ones, and polish them with great sklill. The method of holding the pearls during these operations is very curious; they make a number of holes of small depth in a piece of dry wood, and into these they fit the pearls, so that they are only partly below the surface of the wood, which they then place in water. As it soaks up the water and swells, the pearls become tightly fixed and are then perforated, &c. These operations are all carried on, on the spot.

For many miles along the Condatchy shore, the accumulation of shells is enormous, and averages at least four feet in thickness. This is not to be wondered at, when it is remembered that this fishery has been in active operation for at least 2,000 years. The place itself is exceedingly barren and dreary, and, except during the fishing season, is almost deserted; but at that time it presents an exceeding animated spectacle; thousands of people of various countries and castes, are here drawn together, some for the fishery, others to buy pearls, and others to feed the multitude. They chiefly reside in tents so that it appears a vast encampment.

The pearls vary much in size; those as large as a pea, and of good colour and form, are the best, except unusually large specimens, which rarely occur, the most extraordinary one known being the pearl owned by the late Mr. Hope, which measured two inches in length, and four in circumference, and weighed 1,800 grains. The smaller ones are sorted into sizes, the very smallest being called seed-pearls. A considerable quantity of these last are sent to China, where they are said to be calcined, and use in Chinese pharmacy. Amongst the Romans the pearl was a great favorite, and enormous prices were paid for fine ones. One author gives the value of a string of pearls at 1,000,000 sesterces, or about £8,000 sterling. The single pearl which Cleopatra is said to have dissolved and swallowed was valued at £80,729, and one of the same value was cut into two pieces for earrings for the statue of Venus in the Pantheon at Rome. Coming to latter times, we read of a pearl, in Queen Elizabeth's

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reign, belonging to Sir Thomas Gresham, which was valued at £15,000, and which he is said to have treated after the fashion of Cleopatra; for he powdered it and drank it in a glass of wine to the health of the Queen, in order to astonish the ambassador of Spain, with whom he had laid a wager that he would give a more costly dinner than could the Spaniards.

During the occupation of Britain by the Romans this country became famous for its pearls, which were found in the fresh water mussel of our rivers. Generally the pearls of these molluscs are small, badly coloured, and often valueless; but occasionally they occur of such beauty as to rival those of the pearl oyster. Some years ago, in the Scotch rivers, the search for pearls was prosecuted vigorously, especially by a merchant named Unger, of Edinburgh, who had brought Scotch pearls into great repute. He collected specimens ranging, as was stated, from £5 to £90 each and formed a necklace said to be worth £350. In Scotch pearls of the highest quality, there is a pleasing pinkish tint, which is very permanent. The fishing for pearl mussels is by no means so dangerous or troublesome as for pearl oysters; usually they are found in the beds of streams, shallow enough to wade in, and so clear that they can see the bottom. If too deep to remove with the hand, they are easily captured by putting a stick between their gaping shells, which instantly close upon it, and can be drawn out with it. So profitable did this pursuit become, that a great many persons engaged in it.

Very fine river pearls, known on the continent as Bohemian pearls, are found in the rivers Moldau and Wottawa. There is also a fresh-water pearl fishery in Bavaria, where the river Iltz yields at times very fine specimens. Even the most inferior pearls can only be properly polished with pearl dust, and the inferior pearls are powdered for the purpose of polishing and rounding the finer ones.

False pearls are very admirable imitations, made by blowing very thin beads or bulbs of glass, and pouring into them a mixture of liquid ammonia, and the white matter from the scales of the Bleak and sometimes of the Roach and Dace. The proper way to prepare the pearl-matter is first to remove the scale of the lower part of the fish; these must then be very carefully washed, after which they are put to soak in water, when the pearly film falls off and forms a sediment at the bottom of the vessel, which is removed and placed in liquid ammonia for future use. This pearl mixture, when of the best quality, is very costly, being as much as £4 or £5 per ounce. For use, it is diluted with ammonia, and injected into the glass beads, so as to thinly coat them inside; afterwards the better kinds have melted white wax poured in, which renders them more durable. The French and Germans produce in this way imitations of the finest oriental pearls of such beauty, that the most practised eye can hardly detect the difference. The bleak is procured in considerable quantities for this purpose from the Thames and other rivers in England.

The invention of artificial pearls is due to a Frenchman, named Jaquin, in the time of Catherine di Medici, and the manufacture is now chiefly carried on in the department of the Seine, where great improvements have lately been made, especially in the art of giving the irregular forms of large pearls to the glass-bulbs, and thus increasing the resemblance, and in removing the glassy appearance caused by the exterior glass coating, by exposing it for a short period to the action of the vapour of hydrofluoric acid. Mucilage of fine gum-arabic is also used instead of wax, which increases the translucency, gives greater weight, and is not liable to melt with the heat of the wearer's body—a defect to which those filled with wax are very liable.

Roman pearls differ from other artificial pearls, by having the coating of pearly matter on the outside, to which it is attached by an adhesive substance. The art of making these was derived from the Chinese.

Mother-of-Pearl, the shells of the large bivalve mollusc, *Meleagrina margarifera*, which also produces the precious pearls.* These shells are collected in vast numbers in the tropical seas, chiefly on the coast of Ceylon, Manila, Cuba, Panama, and the South Sea Islands. Those from Panama are small and thick, and are known in commerce as "bullock" shells; those from Manila are finest in quality, often as much as a foot in diameter, round and flat. There are two varieties—the white or silver lipped and the black lipped. So enormous is the trade in these shells, that the imports of this country alone amounted to 3,000 tons

* This is a curious error. Mother-o'-pearl is procured chiefly from large shells of quite a different species.—Ed.

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per annum, the value of which is nearly £100,000. Although large quantities of these shells are consumed in inlaying fancy wood-work, papiermache and in making knife-handles and other small ornamental objects, by far the greater portion is required for making buttons, chiefly in Birmingham.—*British North Borneo Herald.*

To the Editor of the "British North Borneo Herald."

SIR,—Without wishing any criticism to be implied on the Early Notices of North Borneo and Sulu from Chinese Sources which were printed in your issue of the 1st instant, I should like to remark that I was especially struck by the weight of the pearl mentioned in the following passage :—" In the year 1421 (A.D. is supposed to be understood) the mother of the Eastern King (King of Sulu) sent to Court a brother of her late husband, called Paduka Suli; he presented as tribute a large pearl weighing more than *seven taels.*" Now seven Chinese taels are equal 4,137 2/5 grains Troy, which if valued at the present valuation of pearls, presuming the pearl in question to have been of the first quality, would give the grand sum of £41,874. In the estimation of the Chinese it may have possessed a still higher value, seeing the fabulous prices they sometimes put on pearls. That which Julius Cæsar presented to the mother of Marcus Brutus was valued at £48,417 10s; and the one which Cleopatra, in her desire to expend in one feast a larger sum than Mark Anthony had done in his most sumptuous feasts, swallowed with a draught of vinegar; cost about £80,729 35s 4d. The pearl obtained by Philip II of Spain in 1587 from the island of Margarita off the Columbian Coast which weighed 250 carats or 800 grains was valued at $150,000.

To those celebrated pearls just noted must now be added (if credence is to be placed in the Early Notices of Borneo and Sulu from Chinese Sources) the above remarkable one presented by a Queen of Sulu to the Hong-Te of the Kingdom.—Yours, &c. CHIN-CHU.

PEARLS AND PEARLING LIFE.

PEARLS AND PEARLING LIFE. BY EDWIN W. STREETER, F.R.G.S. e (LONDON: GEORGE BELL AND SONS, 1886.)

The book before us, according to the preface, and as far as we are aware, is the only work in the English language which is entirely devoted to the history of pearls. The introductory chapter is immediately followed by one which gives a brief historical account of pearls in connection with India, China, Persia, Palestine, Egypt, Ancient Greece and Italy, and Europe in the middle ages. This is succeeded by a *resume* of the ancient ideas respecting the origin and supposed medicinal qualities of pearls, and by a few words on "breeding" pearls. The next chapter treats of the different kinds of pearl-forming mollusks, both marine and fluviatile. The writer then gives an account of the true mother-of-pearl shell, describing its geographical distribution, the different varieties, its structure, the parasites found within the shells, and their external enemies, their method of getting rid of extraneous substances (stones, small shells, &c.) accidentally introduced within the valves of the shell, and the uses to which the mother-of-pearl is put. The sixth chapter, although headed "The Origin and Formation of Pearls," also refers to the different kinds, such as *bouton* pearls, *baroque* pearls, and *coq de perle*, the mode of life of the oyster, the positions in which pearls are found, &c. It also treats of the qualities which regulate the value of pearls. The next chapter gives a short account of the Sooloo Archipelago, the natives as pearl divers, and their method of dredging. Then follows a good description of the fisheries of North-West Australia and Torres Strait, and this is succeeded by an interesting chapter entitled "Pearling Life at the Present Day," which is practically descriptive of pearling expeditions made by Mr. Streeter's vessel, the *Sree Pas Sair*, from Singapore to the North-West Australian coast and the Sooloo Archipalago. Chapter XI. is devoted to a condensed account of the pearl-fisheries of Ceylon and Southern India, and this is followed by a *resume* of what is known respecting the fisheries in the Persian Gulf, the Red Sea, on the west coast

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of North America, and at the West Indies. Pearls produced by shells which inhabit the rivers and lakes of Great Britain and foreign countries are described in Chapter XIV., and the artificial production of pearls by the Chinese is also here referred to. The different kinds of coloured pearls, and the mollusks which produce them, are then treated of. In the succeeding chapter the most famous pearls of both ancient and modern times are recounted, and the immense sums at which some of them were valued are stated. Chapter XVII. gives the history of the remarkable cluster of pearls known as "the great Southern Cross pearl," which was exhibited in the West Australian Court of the Colonial and Indian Exhibition, and valued by the owners at 10,000*l*. The next and concluding chapter is devoted to the value of pearls, and shows how their worth has varied in this country at different periods from 1671 to the present time.

A map is then introduced showing the principal pearling regions. In an appendix, the works bearing on the subject which have been consulted by the author are enumerated, and a full index completes the volume.

Mr. Streeter has brought together a large amount of information which will be of interest to the general reader, for whom especially, and not for the scientific, the work has been written. The most original material is comprised in the part extending from the seventh to the tenth chapter. The chapter devoted to the Sooloo Archipelago contains some details which, although interesting in themselves, are rather foreign to the subject of the work.

The same observation applies to the account of the constellation *Crux Australis*, or Southern Cross, introduced in the seventeenth chapter.

As far as we have noticed, the various opinions and statements set forth in the work are mostly accurate. It may, however, be questioned whether "there is perhaps no instinct implanted in the human breast more powerful than the love admiration," for is not that of self-preservation supposed to regin supreme? We would point out that the term *Lamellibranchiata* is now supersed by that of *Pelecypoda*, and with good and sufficient reasons is adopted in the latest and best manuals on conchology. The bathymetrical range of bivalvs far exceeds the stated limit—200 fathoms—specimens having been obtained by the *Challennger* and other deep-sea exploring expeditions in depths ranging as low down as 2,900 fathoms.

The book is printed in good legible type upon toned paper, but the pictorial portion mars the rest. The plates illustrating the *Malleus*, the *Meleagrina*, the *Unio*, the *Pinna*, the *Strombus*, and the *Turbinella* are simply execrable. They are printed upon a fearful black ground (one almost expects to see "Sacred to the memory of," &c.), inclosed by a thin white line with ornamental corners, and seem to us to have a most common appearance. We cannot see one redeeming feature in them, the drawing and colouring of the shells being equally bad. If another edition is called for, fresh and accurat illustrations should be provided.—E. A. S.—*Nature*.

[The pearl shells are beautifully engraved in Tennent's Natural History of Ceylon.—COMPILERS.]

THE METHOD OF COMPUTING THE VALUE OF PEARLS AT MADRAS.

Pearls are sold at a certain stipulated price per chour as the parties may agree.

Seed pearls or such as are below 600 sieve are sold by the ounce Troy or other weight.

The chour is more or less valuable as the pearls are more or less perfect or agreeable to existing taste.

At Madras, pearls are strung in lengths nearly about that required for a woman's necklace. Of these strings any number composed of similar pearls and of the same number are collected into a bunch or bundle.

To determine the value of any string or bunch of pearls, any string is selected and cut from the bunch with as little spare silk as possible; this is weighed very nicely by an Indian weight called Manjelin, 20 of which make 1 Collinjee.

The relative values of pearls are in proportion to the squares of their weights, according to which the chour is always calculated from the standard of 1 pearl weighing 1 Manjelin being nearly equal to ¾ of a chour.

Pearls are distinguished by the sieve or searse through which they have passed, and by the number of such which will weigh a Collinjee. Thus a certain sieve will pass pearls of a manjelin each precisely, and this may be called 20 sieve.

1 pearl of 20 sieve is equal to ¾ chour sieve and 1 collinjee is equal to 15 chours.

1	pearl	40	sieve	3/16	chour sieve	1	colinjee	7½	chours
:	do.	60	do.	1/12	do.	1	do.	5	
1	do.	80	do.	3/64	do.	1	do.	3¾	
1	do.	100	do.	3/100	do.	1	do.	3	
1	do.	200	do.	3/400	do.	1	do.	1½	
1	do.	300	do.	3/900	do.	1	do.	1	

This small table may serve to show the relative value of pearls, but is formed from my own idea and may, therefore, err.

When buying by the manjelins the following rule will lead to the number of chour:—

Put M for the weight of single string in manjelins and fractions.
„ N for the number of pearls on a string.
„ S for the number of strings of the same kind in a bunch.

Then $\frac{3M_2S}{4N}$ is always equal to the number of chour in a bunch and if V be put for the value of 1 chour then $\frac{3M^2VS}{4N}$ will give the price of the bunch. These Algebraic forms may be thus reduced to Arithmetic rules:

1. multiply the number of manjelins by itself and the product by the number 3 and this last product by the number of strings.
2. Divide the last product by 4 times the number of pearls on a string, the quotient will be the number of chour in the bunch.
3. The number of chour multiplied by the number of pagodas per chour will give the value of the bunch.

The weight in manjelins generally including fractions, it becomes operose to calculate by simple Arithmetic; therefore, the following method by logarithms is preferable:—

1. To the constant logarithm (of ¾ or) 9,87500 add twice the logarithm of the number of manjelins in one string, and the logarithm of the number of strings in the bunch, reject 10 from the index of the same.
2. From the above sum of logarithms, subtract the logarithm of the number of pearls on a string, the difference will be the logarithm of the number of chour in the bunch.
3. To the logarithm of the number of chour, add the logm. of the price per chour, and the sum will be the logm. of the price of the bunch. Thus for example :—

I have a bunch of pearls consisting of 3 strings. Each string has 98 pearls and weights 17 7/16 manjelins, or precisely 100 grains at 12 pagodas a chour, I wish to know the number of chour and its value?

Constant logm...	9,87500
17 7/16 or 17,437 manjelins its logm.	1,24147
The same repeated	1,24147
3 the number of strings its logm.	0,47712
The sum rejecting 10	2,83506
98 the number of pearls on a string	1,99123

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Given the number of chour 6,98	... ...	0,84383
12 the number of pagodas per chour	... ...	1,07918
The value of the bunch is 83¾ pagodas	... ...	1,92301

In order to have a certain check on native merchants as well as to know the value of pearls at any time, I sought the value of a manjelin in the Calcutta Directory where it says the manjelin is 1½ carat, of which 572 make an ounce Troy. This would make the manjelin be to the grain Troy as 19 to 24 nearly, which is wrong. But an experiment shewed me that the string in the above example weighed precisely 100 grains Troy. So that each manjelin is nearly equal to 5¾ grains; and a single pearl weighing 6¼ grains is equal to 1 chour from which the following rule is deduced substituting W for M in the form before given $\frac{S\ W_2}{43{,}8535\ N}$ = number of chour and this multiplied by V will give the value. The above rule by logarithms is applicable to the ease when weighed by Troy grains substituting the constant logarithm 8,35763 for that before given, and using the weight by grains instead of manjelins.

Constant logm	... ...	8,35763
100 grains	... ...	2,00000
Do.	... ...	2,00000
3 strings	... ...	0,47712
		2,83475
98 pearls on a string	... ...	1,99123
Give 6,975 chour	... ...	0,84352
12 pags. per chour	... ...	1,07918
Give 83 7/10 pagodas	... ...	1,92270

or 83 pag. 31 fan. 40 cash the value of the bunch of three strings.

In 1812 the price per chour varied between 9½ and 10 pagodas for the larger pearls which generally sell for less the chour on account of the few purchasers for such valuable articles, but those from a grain and half down to those of 1/5 of a grain each when perfect sell dearer as being in constant demand. These could be had from 9 to 12 pagodas per chour, they have been sold to pursers of Indiamen for 15 pagodas and those not of the best kind.

In purchasing by the chour ⅛ per cent may be allowed tare for the silk on which they are strung, but this is such a trifle as need not be looked after.

I do not know at what size seed pearls are so called, but I imagine when about 600 or 700 sieve, these are strung in the same manner as the others, and are sold by the ounce weight, but the merchants at Madras attach large tassels of silk to the bunches which are weighed in with them and a certain percentage allowed on this for tare. These tassels may generally be reduced one-half and then allow a tare of ten per cent.

Good seed pearls are most valuable in proportion to their price when they are good—for they are always in demand—they may be bought from 9 to 5 pagodas the ounce and are worth in England from 8 to 10 guineas.

The rules above given are absolute, but tables might be made which would render the operation quite simple.

Cornelia, 15th Nov. 1812. W. O.

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GOLD AND GEMS.

Tuesday, March 15th, 1887; Sir GEORGE BIRDWOOD, M.D., LL.D., K.C.I.E., C.S.I., in the chair.

The Chairman, in introducing Mr. Phillips to the meeting, said:—I have to congratulate the Society on his having kindly consented to prepare and read the paper for this evening—"The application of Gems to the Art of the Goldsmith." The firm of which he is now the head was founded more than fifty years ago by his father, Robert Phillips, who was the regenerator of art-goldsmiths' work in this country, when it had fallen into its deepest abasement, between the close of the great war with Bonaparte and the ascension of Queen Victoria to the throne of the United Kingdom. He spent most of his life, as his son has since done, in travelling throughout Europe for the yearly improvement of his art, to which he gave his entire devotion, and in which he gained the greatest distinction for himself and his country, earning the highest jury awards at the Great Exhibition, of 1851, in London, the Universal Exhibition of 1855, at Paris, and the 1862, London, and 1867, Paris, International Exhibitions. At the Paris Exhibition of 1878, he was a juror, *hors concours*. He received also the decoration of the Legion of Honour from the Emperor Napoleon III, and the Crown of Italy from King Victor Emanuel, as marks of their personal recognition of his uuique reputation as an English art jeweller. His son, Mr. Alfred Phillips, in succeeding to his father's business, has been worthily walking in his father's footsteps, to the great gratification and pleasure of all who, like myself, have enjoyed the hereditary friendship of his family. But not only has a thoroughly practical and most interesting paper been prepared for us to-night by Mr. Alfred Philips. Through the courtesy of several of his patrons, it will be illustrated by some of the noblest and choicest works that, during the past ten years, have been produced by Messrs. Phillips Bros. and Co. A rare delectation has, in this way, been provided for this evening's meeting, for which all present will, I am sure, be sincerely grateful to the Duke of Westminster, Lord Revelstoke, and Sir W. McCormack, and the other noblemen and gentlemen who have helped to make up the enchanting display.

The paper read was—

THE APPLICATION OF GEMS TO THE ART OF THE GOLDSMITH.

By ALFRED PHILIPS.

My subject being one of the series in furtherance of the views, and I have a right to say the hopes, cherished by the Applied Art Section of this great Society, that the impetus of art application, wisely directed, be imparted to the various industries at present more or less flourishing in this country, I have had in constant view, while compiling the various fact which I now venture o sub mit for your consideration, the desirability of chiefly addressing myself to those applications fittest for the existing age and its requirements.

I do not propose, therefore, to recapitulate this evening an absolute chronology of the application of gems from the earliest periods, but elect to base my remarks with reference to the progress of goldsmithery upon the traditions which have survived from a comparatively recent period, namely, the early part of the 15th century, when precious stones came into liberal employment, finding their chief use as objects of personal adornment, distinct from the mystic and religious purposes to which they were applied during the earlier ages.

That gems were firstly so employed was doubtless due to their extreme rarity, inestimable price, and the consequent impossibility of their becoming articles of familiar commerce.

To the archæologist and the historian there is, without doubt, much that is vitally interesting in the use of precious gems and amulets throughout the early ages; and, so far as we are concerned to-night; there is this much which is indispensable to our argument, namely, the well known fact of the ever-increasing estimation in which gems have been held since the days of

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Moses, under whose rule we know them to have been used, whatever may be the controversy as to their form and nomenclature, as priestly adornments.

The breastplate of Aaron may be considered as a species of regalia, illustrating, as Crown jewels do, priceless possessions, beyond the purchase of individuals.

For identical reasons, the greatest interest must attach to the accession of Constantine, whose crown is accepted as the earliest instance of the jewelling of the chief symbol of empire.

From that time forward, we note the everdeveloping luxury in the regalia of all civilised and indeed many half-civilised nations, and we may thereby admit the fact that so far, throughout successive centuries, the Crown jewels of European nations have furnished the chief outlet for gems of abnormal size and value. By the same token, barbaric nations have absorbed into their regalia gems of corresponding importance in their more primitive forms.

Again, archæologically speaking, nothing should surpass our interest in the engraved signets of Greece, at the remote period of 600 years before Christ, as well as, even at that early age, the production in rude form of some of the nobler gems, such as rubies and sapphires, besides those others which, from their inferior hardness, are classed to-day under the semi-precious category, as for example amethyst, chrysolite, coral, amber, and opal.

Before abandoning the subject of early engraved gems, my own experience impels me to deny, in common with Lessing and other authorities, the existence of any admitted engraved gem of the early Greek period cut in a true ruby, for the simple reason that this finest quality of corundum cannot be satisfactorily incised by means of the *punctum lapidis* of the ancient engravers, which was nothing more than a lower formation of sapphire, of white or pale blue colour, said to have been found in the Island of Cyprus and imported into Greece under the name of adamas, for the primary purpose of gem engraving.

The punctum lapidis efficiently engraved the many gems of inferior hardness to itself, such as banded agates, sards, jasper, and the like, as well as the softer pellucid gems, as, for example, garnets, chrysolites, and formations of quartz.

It will easily be conceded that the diamond, if known at all in Pliny's time, was neither susceptible of manipulation by any art of cutting then existing, nor was it, in its crystallised form, applicable to the extensive intaglio engraving which the Greeks are known to have conducted. Without absolutely denying the treatment of the commoner qualities of sapphire by such a process in the earlier period, I should, with Mr. King, regard with extreme suspicion an incised work in fine sapphire ascribed to that age.

In support of my view, the ancient Greeks are known to have employed for ornament the true sapphire (Hyacinthus) in most cases, not only uncut, but barely shaped and crudely polished on the upper side only.

The two renowned gems, cut in sapphire, which once graced the Marlborough collection, belong to a later period, when the diamond was known as an incisor, the one being a portrait of Caracalla, A.D. 211, executed during the six years of his reign, and the other a head of Medusa, which conveys to me the impression of having been cut with the diamond. Both these gems possess the brilliant finish which only the diamond can impart.

Extravagant use was made of the gems and precious metals in Solomon's time, both in the secular cause and that of the magnificence of the temples and the priests. The gems, which had been more of mysteries than merchandise, were, in advance of the times, gradually becoming objects of commerce.

Large application was made of precious stones during the reign of Alexander, especially those of Indian origin, the use of which was no doubt prompted by the more educated craftsmen who followed in his wake through Eastern dominions.

The anxious student, desirous of tracing back to early sources the application of precious gems, finds himself continually checked by the utter ignorance of their technology which prevailed from the time of Moses to far beyond the time

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of the Romans possessing themselves of Asia and Africa. Then it was, as w all know, that the lavish use of precious stones, under Imperial rule, grew to be such an abuse that it was needful to frame laws curtailing that luxury, which was fatally contributing to the decline of a great empire.

Even under Constantine and his successors the technical acquaintance with the gems had scarcely improved, but they were better manipulated and more extensively applied.

A more reliable supply of gems had created increased familiarity with their general characteristics, and led onwards, by successive steps, to the assiduous attempts which were made during the Christian era to satisfactorily deal with the diamond as a finished gem.

At last, in the early part of the 15th century, this desideratum was accomplished. Diamond cutting may then be said to have inaugurated a great industry, while the real foundation had been thereby established for the application of finished gems, manufactured, if you approve of that term, out of the rough material, in something approaching the perfect development of today.

Before approaching the subject of the modern applications of the gems, it seems proper that some reference should be made to the general history of the ruling varieties which, in all ages, have constituted the staple commerce in precious stones. I refer, naturally, to the diamond, the ruby, the emerald, and the sapphire.

The so-called diamond of the Septuagint was no doubt the jasper. This may be the more readily conceded, practice having taught us that the diamond of Aaron's breastplate could not have been the diamond of our time, inasmuch as it was engraved. The engraving of the diamond, then absolutely unknown, is even in these days a necessarily imperfect process, savouring more of the abrasion of a gem than of its legitimate manipulation. Diamond engraving should be stigmatised as the unprofitable accomplishment of the ruin of a gem, which, unlike its fellows, depends solely upon its unrivalled lustre, and should be condemned with all other misapplications of skill.

The diamond is deservedly the foremost of the gems. My subject being that of application, I cannot too soon remind you of the commencement of its general employment as a finished gem in France during the first quarter of the 15th century. The use of the diamond continued with unabated extravagance throughout the succeeding reigns of the French kings, especially that of Francis I., who not only encouraged its production, but the art of applying it to personal ornament.

All of us can feel how powerful an impetus was given to the art of the goldsmith when men like Cellini were welcomed to the courts of great monarchs, and there treated with friendship and liberality; neither is it difficult to ascribe a reason for the rapid spread of the jeweller's arts of Italy and France to the other countries of Europe, once the great example of their protection had been set by monarchs.

I pause for one moment to reflect upon the relative luxury which heralded the employment of diamonds in the 15th century. When we consider that in 1421 the revenue of England was under £56,000 of our money, and that of France apparently not in excess of that amount; when, in 1428, such a reverse as that we experienced at Orleans was sufficient to cripple our finances, striking the first blow at our power in that country, we need not ask ourselves why the sumptuary laws were soon after established.

We need not wonder that the luxury of an Agnes Sorel, or a Duchesse d'Etampes, could menace the resources of an entire dynasty, inestimable, for all that, as we have found the art traditions of those days.

Diamond cutting was practised in Paris, to a small extent, in the early part of the 15th century, but it is easy to perceive, from the specimens handed down to us, how primitive was the result, as compared to the magnificen manipulation of today.

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As an industry already worthy of the name, it was conducted at Bruges towards the end of the same century, whence, we are told, the apprentices once more migrated to Paris, some of them also founding establishments in Amsterdam, the present centre of the diamond industry.

Cardinal Mazarin, a lover and enthusiastic collector of gems, protected and regenerated the art of diamond cutting in Paris during the second half of the 17th century. Since the year 1800, the Dutch industry may de said to have triumphed over all others. From that time diamond cutting has never been an important trade either in London or Paris, in both of which capitals, however, work of the highest perfection continues to be carried out.

Mr. Coster, formerly at the head of the diamond cutting industry of Amsterdam, considers that the unprecedented quantity of 2,500,000 carats of diamonds are now annually cut in that city. We must admit this to be an illustration of expansion, unequalled in any other trade since 1800, when the same city scarcely averaged an output of 15,000 carats.

There seems to be some justification for this gigantic estimate, inasmuch as motive power, now so easily obtainable, permits some 2,000 independent workmen to operate in their own homes, outside the sphere of statistical observation. From data, however, which I have collected in Amsterdam while compiling the facts for this paper, I find that the city is known to employ 8,000 skilled splitters, cutters, and polishers, producing an average during the last five years of 20,000 carats per week, or 1,040,000 carats per annum. At this moment it is believed that Amsterdam, in its, regular workshops, is turning out 1,500,000 carats per annum.

It may truthfully be said of remarkable diamonds, up to the recent time of the Cape discoveries, that their value was vastly overestimated. It seemed as if, because they were far beyond the reach of ordinary buyers, there could be no harm in over-stating their value to an extent simply based upon their weight, but with little reference to the actual quality of the gems.

A glaring instance was Romé de l'Isle's estimation of the Braganza diamond, weight 1,680 carats, which he says was worth £224,000,000 sterling, or about £80 sterling per carat for the multiplicant of the square of its whole weight. This is aside from the fact that the Braganza has never been proved to be a diamond.

Again, the Orloff diamond* of the Russian sceptre, weighing 193 carats, was, in the year 1800, supposed to be worth £4,854,728 sterling although its actual cost was 135,417 guineas.

The monster rose diamond of the Great Mogul weighed 279 carats, and was valued at 380,000 guineas, and so on, until we come to the Regent, weighing 136¼ carats, and valued at 208,333 guineas, although its actual cost was half that amount. The most palpable absurdity, however, is Dutens' valuation of that uninteresting gem, the Sancy, weighing 55 carats, which he states to be much above 25,000 guineas. I can find no contemporary estimate of a diamond of similar weight at more than £9,500.

The foregoing instances apply exclusively to the diamonds of the various East Indian localities, known in our markets as "Golkonda," which had been explored since the time of Alexander, and which had yielded the total supply of these gems until the Brazilian discovery in 1720.

The East Indian diamonds are by many authorities said to have been of finer quality than those of more recent dicovery. While I do not share that opinion, I admit that they yielded a larger proportion of pure gems, and that they are both denser and harder than any others. I am confirmed by Thomas Collingwood Kitto as to their greater hardness, and by personal experiments

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*** Orloff paid the merchant from whom he obtained this gem the sum of £90,000 in cash, besides giving him an annuity of £1,000 a year. It may interest you to know that the true name of the "Orloff" stone is said to be "Koh-i-Tûr," or "Sinai."—Edwin W. Streeter.**

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with reference to specific gravity. Ellicott's exhaustive experiments in 1795, and those of Page, published in 1855, both prove the Oriental diamond to be of greater specific gravity than the Beazilian gem.

If one may judge by the superb old parures of Golkonda diamonds still extant, and eagerly sought after, the assertion may be accepted that East India yielded a larger per-centage of white stones. Indeed, it is well known that the various shades of yellow and cinnamon coloured diamonds were infinitely rarer before the opening of the Brazilian mines, and even then comparatively seldom, until the Cape mines produced an abundance of this particular class of diamond.

It would be impossible to frame a reliable estimate of the quantity and value of diamonds exported from India under British rule, as there was freetrade in diamond seeking. The supply of Indian diamonds is now most uncertain, no noticeable quantity having been brought to this market for the last forty years.

The discovery of diamonds in Brazil in 1720 was followed in 1721 by the export of 173,000 carats to the European markets. As may be supposed, the value of diamonds considerably declined for a time, until the increased supply had, *ipso facto*, created relative application and demand. Shortly afterwards the Brazilian Government having assumed the working of the mines, the industry was successfully conducted until 1880, when the Cape diamonds, which were produced at a much smaller cost, reduced Brazilian mining to a minimum.

The present total export of diamonds from Brazil does not exceed 24,000 carats, of which it is estimated that 30 per cent. are of pure water, as against 20 per cent. of the same quality from South Africa, where, however, the crystals are found of much larger sizes than they ever have been in Brazil.

It cannot too emphatically be asserted that the qualification of "Cape diamond" applied to the South African gems as a term of reproach, should now and for ever be retracted by those persons who, knowing better, have been foolish enough to propagate such nonsense.

Cape diamonds furnish, to-day, fully 95 per cent. of the European supply, which alone is sufficient to uphold them in public estimation. It is true that colourless diamonds have been found, in the smallest proportion in South Africa, but it is equally beyond dispute that large numbers of the whitest and most faultless diamonds are exported from the Cape, while the mass of material is conspicuous, whether white or coloured, for its brilliancy.

Disparagers of South African diamons were usually interested in supplies of rough from other localities, and continue to fear that the public mind having been so industriously prejudiced against all dinominations of African diamonds, purchasers would *hold* aloof if the goods were fairly represented.

It is not generally known that, during the first fourteen years of its career, the then most prolific of South African mines, the Kimberly, put out more diamonds than all the other sources of supply combined had produced since any record had been kept. Diamond mining commenced in earnest at the Cape in 1871, and developed with marvellous rapidity. Upon the authority of Mr. J. B. Finlason, chief inspector of diamond mines, I give the following statistics:—In 1880, the usual digger's claim, 31 ft. square, was equal to the unprecedented value of £32,000, readily realised. In 1874, the total shipments from the Cape amounted to £5,000,000 sterling. The Postmaster-General reports that between January 1st, 1874, and December 31st, 1877, the net weight of diamonds sent to England by post amounted to one ton. The Government returns of duty paid on diamonds, shipped from September, 1882, to February, 1884, amounted to £4,428,157, and weighed 3,617,226 carats.

In connection with the developing use of precious stones, but more especially the diamond, it is impossible to overrate the significance of the Table of Statistics given below, for which I am indebted to the painstaking courtesy of Messrs. Tiffany, the eminent goldsmiths, of New York.

These gentlemen have used their influence with the Government of the United States of America, in order to procure the most perfect form of tabular

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information, vouched for up to February 24 of the present year by the Chief of the Bureau of Statistics of the Treasury Debt. It will be at once recognised that America is the only country capable of furnishing such unquestionable evidence of the large increase in the application of diamonds since the Cape discoveries revolutionised the whole trade.

Not only are precious stones duty free in the chief European countries, but no record is kept upon which it would be safe to found even an approximate estimate of their consumption.

STATEMENT

Showing the value of Imported Precious Stones for consumption in the United States, together with the rates of duty on each kind, during the year ending June 30th, 1867, to 1886 inclusive.

Year ending June 30.	Precious Stones. Not set. Of all kinds, except rough or uncut Diamonds, after 1872, 10 per cent.	Precious Stones. Not set. Diamonds, rough or uncut, free of duty.	Precious Stones. Set, 25 per cent.	Precious Stones. Diamonds (Glaziers'), 1867—72, 10 per cent.; after 1872, free of duty.	Precious Stones. Diamond Dust (or "Bort") 1867—71, 20 per cent.; after 1871, free.	Imitation. Not set, 40 per cent., except 1874—1886, 10 per cent.	Imitation. Set, 30 per cent.
	dols.	dols.	dols.	dols.	dols.	dols.	dols.
1867	1,317,420	*a*	291	906	...	*d*	*d*
1868	1,060,544	*a*	1,465	484	...	*d*	*d*
1869	1,997,282	*a*	23	445	140	*d*	*d*
1870	1,768,324	*a*	1,504	9,372	88	*d*	*d*
1871	2,349,482	*a*	256	976	1,249	*d*	*d*
1872	2,939,155	*a*	2,400	2,386	89,707	...	2,733
1873	2,917,216	176,426	326	*c*	40,424	36,074	2,574
1874	2,158,172	144,629	114	*c*	68,621	161	4,664
1875	3,234,319	211,920	...	*c*	32,518	217	1,128
1876	2,409,516	186,404	45	*c*	20,678	1,098	1,310
1877	2,110,215	78,033	1,734	*c*	45,264	1,455	488
1878	2,970,469	63,270	1,026	*c*	36,409	1,335	1,091
1879	3,841,335	104,158	538	*c*	18,889	10,831	23,100
1880	6,690,912	129,207	765	*c*	49,360	1,898	12,118
1881	8,320,315	233,596	1,307	*c*	51,409	1,592	6,857
1882	8,377,200	449,513	3,205	*c*	92,853	1,433	11,818
1883	7,598,176	443,996	2,081	*c*	82,628	468	3,028
1884	8,712,315	367,816	*b*	23,208	37,121	88,618	*b*
1885	5,628,917	374,679	*b*	11,526	30,426	13,474	*b*
1886	7,915,660	302,822	*b*	8,949	32,316	27,574	*b*

a Included under "of all kinds."
b " " "Jewellery of all kinds."
c " " "Diamonds, rough or uncut.
d " " "Precious stones."

(Signed) WM. T. SWITZLER,
Chief of Bureau.

TREASURY DEPARTMENT,
STATISTICAL BUREAU,
February 24th, 1887.

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I elect to refer conjointly to the ruby and sapphire, because although no two denominations can more considerably vary in commercial value, they form the same body, differing only in colouring matter. The ruby, at any rate since 1700, has remained the most highly valued of the gems. A ten carat ruby, at that time, was worth £1,300.

I possess the record of the sale of a twenty carat ruby for £8,000, or considerably over double the value in 1700. About the year 1800, fine rubies of one carat were valued at about 10 guineas, but a six carat stone was recorded to have been sold for £1,000. It is not uncommon, in these days, to obtain £150 for a specimen ruby of 1½ carats.

From these facts it is easy to conclude that fine rubies prohibit current application, but it should be remembered that artificial prices refer only to gems of the true "pigeon blood" colour, untainted either by brown or violet. The high price of the ruby is likewise due to the uncertainty of the supply, and to the hoarding of the principal gems by Eastern princes.

It will be interesting to mark the influence upon rubies, once European control shall be definitely established over the Burmese mines. There are those who assert that these mines, scientifically worked, are destined to yield up a vastly increased quantity of this most precious material. If this were verified, rubies must diminish in value, but, on the other hand, a flourishing trade would spring up, as was the case with sapphires when the prolific discoveries in Kashmir reduced by 50 per cent. their market value, and admitted their application to jewellery within the reach of moderate incomes. Others affirm that the Burmese ruby mines, which have been uninterruptedly worked from early ages, are exhausted with reference to important gems, and that rarely is a stone produced of more than half a carat. My own experience shows this to be an exaggeration. On the interesting occasion of my report to the Indian Government upon the Burmese loot, I found, on the contrary, that a very large proportion of the rubies exceeded half a carat in weight. Of the quality, however, I must say that not one-hundredth portion was suitable for facetting, or for the European market. If such may be taken as representative of the Burmese supply, it seems right to conjecture that slight cheapening influence will be brought to bear upon rubies of high quality.

The sapphire, as I have said, is another coloured ruby. It is curious to note that blue-tinted corundum has always occurred in larger quantities than red. The sapphire, which once was next in value to the ruby, is to-day the cheapest of the major gems, and yet from its intrinsic beauty, and unrivalled blue colour, its disappearance would be to the art goldsmith a greater misfortune than that of either the ruby or the emerald, neither of which seem to have enjoyed the same sentimental association as the sapphire which, among many uses, we constantly find employed as an episcopal gem.

Commercially viewed, the sapphires, both blue and yellow—the last known as Oriental topazes—were almost of identical value about the year 1700. In fact, the value of all sapphires below 30 carats was even less than it is to-day. Here we have reference to parcels of stones averaging 6 grains at 40s. per carat, and to a fine 30 carat sapphire valued at £400. About 1830, sapphires began to rise to exorbitant prices, which were maintained until about six or seven years ago, when the large quantities of rough brought from Kashmir and Siam literally glutted the markets, which scarcely yet can be said to have recovered their normal condition. If the supply be fifty times greater than at the beginning of last century, the demand created by the very cheapening of sapphires is practically certain to stay further decline in value. As an illustration of the plenteousness of sapphires, I recently received in one and the same consignment 1,300 stones, weighing 4,626 carats, the sterling value of which was £16,680, or an average per carat of £3 12s. 1½d.

The emerald, or *smaragdus* of the Latins, is one of the most beautiful, although the softest of the precious gems, easily fusible with borax into a colourless glass. The huge emeralds of Pliny and Theophrastus must have been either crystals of beryl—

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known to occur of a large size, and of which the emerald itself is the precious type—or else masses of green quartz. The true emerald occurs in crystals seldom over one inch in length. The Indian emerald has been applied both to signets and personal ornament alike in Ancient Greece, Italy, Egypt, and Arabia.

It must not be confounded with the so-called Oriental emerald of India, which is nothing less than a green ruby or sapphire, characterised by its sap-green colour, and, however curious as a gem, undeserving of the appellation of emerald.

The extraordinary rise in the value of this gem since the year 1700 has known many fluctuations. The basis of valuation up to 1710 was one quarter of the price of table diamonds of same weight, or about 3s. 9d. per grain. A 10-carat emerald was worth about £160. From 1720 to 1780 the quantity of emeralds brought to the European markets had so largely increased as materially to diminish their value. At the end of last century rough emeralds were sold at the following approximate prices:—Inferior small, 20s. per oz. troy; medium small, 40s. per oz. troy; fine small, £8 per oz. troy; fine medium small, £10 per oz. troy; while the very best rough, in larger sizes, fetched only £15 per oz. troy, equal to 151½ carats.

Parcels of emeralds, now very rare, of medium colour, are offered at from £10 to £15 per carat. I have purchased small emeralds of good colour, within this month, at £6 per carat.

I should like to dissipate an idea frequently entertained by amateurs that the commercial value of many of the abnormal specimens of emerald on record is in proportion to their size, as for example, the Duke of Devonshire's emerald, weighing 1,360 carats; Duleep Sing's emerald, measuring 3 in. by 2 in.; and a large sexangular emerald recently looted at Mandalay which while its weight approximates to 200 carats, is distinguished by size but not quality.

THE MINOR GEMS.

I regret that time this evening only enables me to sketch the outline of a chapter always dear to the art goldsmith. The application of the minor or æsthetic gems, as they are often called, has possessed a peculiar attraction to the craftsmen and purchasers of many ages.

It is true that from the times of early Greek art most of the gems enjoyed their mythology, but it is no less a fact that the important group of semi-precious gems, classed by their commercial value to-day, seem to have been those most involved in the legendary fable pervading the Christian era. The exquisite tones peculiar to these gems of lesser value establishes them as a separate category when compared to the magnificent or acknowledged gems. Their natural beauties could not fail to endear them to the artist in search of that which is best adapted to the harmonies of the *cinque cento*.

I do not think it possible for any gem to arrogate a greater art value, for example, than the amethyst, worn in the Middle Ages as an amulet and preservative in battle, besides being one of the pious or episcopal gems, invariably to be seen in the shrines, frequently centring the bishop's morse, incrusted in the chalices of Italian and German art—in short, playing its part wherever it was desirable to impart serious beauty or dignity to the property of the Church.

To say that the amethyst, because it is only a beautiful variety of coloured crystal, should descend from its eminence as an art gem, would be to assert that which no artist could feel. If it were only as valuable as the sapphire, it is easy to believe that its popularity would be even greater.

Then we have the chrysolites, the topazes of various hues, the beautiful family of the garnets, Oriental varieties of which ranked with gems of higher order rather more than a century ago.

The peridot, which is worthy of a denomination of its own, other than its generic name of chrysolite, in spite of its softness, ranked with the gems from the 15th to the end of the 17th centuries, doubtless by reason of its perfectly artistic colour.

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What is more beautiful in nature than the opal, and what more discreditable to the age of sober materialism in which we live, than the baseless conspiracy to attribute consequences of misfortune to the wearer. The Hungarian opal ranked with the principal gems when it was an article of familiar commerce in our markets, but now that a quite modern slur has been cast upon this lovely gem, it has naturally fallen in value to a considerable extent. Surely a gem which in ancient times was held in the highest repute, first for its beauty, and then because its very own mythology constituted it a harbinger of love and goodwill among men, should, in these days, triumph over the silliest of silly prejudices.

The selenite, or moonstone, deserves notice as a lesser gem of great beauty. There is hardly a stone admitting a greater variety of applications, the admirable softness of its tint enabling both coloured gems, diamonds and enamels, to happily be associated with it. I have sought to demonstrate this by the various examples I am submitting to you to-night of the semi-precious gems in their applied forms.

Of the unmounted gems shown to-night, I would instance the unique specimens of beryls which recently passed out of my hands into the collection of a noble patron of art, to whom I am greatly indebted for the opportunity of displaying representative beryls such as no museum has acquired.

I am likewise indebted to Lord Revelstoke for the interesting opportunity of exhibiting to you the *saphir merveilleux* of Egalité Duke of Orleans, for many years an ornament of the Hope collection and in addition to its remarkable history, a conspicuously beautiful gem.

Another great patron of the precious gems has enabled me to show you a remarkable parure of brilliants, assembled by me during the past year, the perfect brilliancy of which testifies at once to the quality and manipulation of South African diamonds.

APPLICATION.

At the present moment the beautiful lapis lazuli is sharing unmerited oblivion in common with onyx and, in short, most of the opaque and semi-opaque stones, upon which alas we had learned to rely no less than the great classic goldsmiths of Rome. We valued them beyond price as a consistent accompaniment of plain gold work, of that high order which lacks repose, in conjunction with the flashing gems.

When I look back to the magnificent results obtained by those golden ornaments at a comparatively recent date, I can but lament, whatever the cause that classic goldsmithery should practically have become a joy of the past' Irresistibly developing as is the patronage of the pellucid gems, I grieve to think there should no longer be sufficient large-heartedness to enable such priceless traditions to abide with us, in the once cherished form of sober and dignified personal ornaments.

Classic and, indeed, art goldsmiths' work, both that which was plain and that adorned by the various gems consistent with its character, was introduced into this country as an industry by my lamented father, Robert Phillips, about half a century ago. The travelling companion through Italy of Owen Jones, Digby Wyatt, John Gibson, and two generations of the Castellanis, he was not slow to perceive, with reference to his own art, the benefit likely to result from a radical improvement in the public taste for jewellery, either reproduced from antique or mediæval sources, or conceived in the spirit of those ages.

From that time, until some eight years ago, the good work proceeded, under the auspices of my father, an enthusiastic untiring revivalist, who accomplished his object with the disinterested feeling of an old master, rather than a man influenced by the ratio of its commercial success.

It must not be understood that this art of reproducing classical jewels, and accomodating them to modern uses, was heartily responded to at the outset of my late father's labours. It came as a surprise, not to the few cultured

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persons, but to the many who had never asked themselves why personal ornaments should be endowed with a sentiment, a meaning, in short, a life of its own.

Emblematical ornament stood sadly in need of regeneration. Its introduction found the current taste of this country at a very low ebb, powerfully prejudiced, as it was, in favour of the utterly nondescript style which prevailed at that time and for many years afterwards.

I am sure that you will agree with me, that no more fitting occasion than the present could be found for the expression of my gratitude to Sir George Birdwood, our chairman this evening, for the valuable information he has imparted to me during the past seven years, with particular reference to symbolical jewellery.

The art of symbolism, which must not for one moment be dissociated from that of the goldsmith, indeed deserves a fuller share of recognition at my hands than circumstances permit to-night. Inasmuch as this interesting subject is being fully developed by Sir George Birdwood himself, in an enlarged work on the industrial arts of India, which he is now preparing for the Press, I shall not explicitly refer to communications which have been made to me in confidence. Briefly noticing Sir George Birdwood's views, which so far have been most ably stated in his already published works on Indian art, I may say that he considers jewellery other than symbolical to have no *raison d'etre*, and to be unmeaning as mere ornament.

What is there which better conveys the influence of emblematical art than Shelton's able definition—that it is a picture imaging forth a truth or lesson by some figure or scene, a picture representing one thing to the eye and another to the understanding, and a device charged with some moral instruction. I have always held emblematical ornament to be the root of all decoration, and, therefore, attributable more or less to every style, however primitive or debased.

Such a belief should set every thinking goldsmith longing for the promised grammar of symbolisms. Sir George Birdwood gives an astronomical origin to nearly every conventional design in ancient jewellery and indeed art generally, and even goes so far as to say, in which I cannot myself agree, that the breastplate of Aaron is of the nature really of a zodiacal palladium.

Once that prejudices had been partially conquered, success was not greater than had been anticipated. The apogee was reached at the Paris Exhibition of 1867, from which point a gradual, but uninterrupted, decline must be recorded in the popularity of jewellery of the Greek, Etruscan, and Roman types, but not so, happily, of those which were based upon the various schools distinguishing the Christian era.

The richest field of research afforded to the art goldsmith, and that which has never ceased to command allegiance, is the Renaissance. Upon this is destined to be founded all that is worth calling art, in the prospective periods of the goldsmith's craft. Here is the true basis of the art of the goldsmith, the enameller, the jeweller, and the chaser, all of whom merged into one man—in Cellini's person, the *facile princeps* of his craft. Here are the veritable treasures of tradition, to which the apprentice may turn with the certainty that his time will be well spent, his labours fruitfully repaid. The workman once capable of interpreting this school is master of his craft.

However capricious may have been the public taste since the inauguration of a style and method which might consistently be called the birth instead of the re-birth of art, with regard to the destinies of the modern goldsmith, support has never been absolutely wanting. Unreal or bastard styles have flourished meanwhile, one knows not why, but have as surely died out from lack of that imperishable quality of design pervading all decoration alike in the 15th and 16th centuries.

The revival of the Glyptic arts went hand in hand with those of the goldsmith, the one becoming the natural coadjutor of the other; the one, as it is to-day with the precious gems, creating and sustaining the demand for the other.

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Enamelling upon gold, with all its beauties and mysteries of production, seemed, as if by magic, to have developed into a well-nigh perfect art, in potent and inseparable alliance with that of the goldsmith. Truly mysterious, as of the alchemists, were the secrets of the old enamellers. Each possessed the valuable fruit of his own discoveries, before manufacturers provided the vulgar supply of orthodox colours which has done so much to check the patient invention of the individual. Now, as then, to a lesser degree of course, we seekers promote individual experiment to our utmost power, devoting ourselves again and again to the improvement of our colours and the alloys of gold most favourable to their production, until it seems that in this important direction, we have little more to learn.

If we except the emamel painting of Bordier's and Petitot's schools, as well as some of the conceptions, though not the process of Limoges, all good judges will admit that the technique of the Renaissance has not only been reached but surpassed within the last hundred years.

The specimens offered for your inspection to-night afford evidence of British development of translucent enamels, second to none which have been founded upon the almost invariable champleve of the Renaissance. I do not propose to call your attention to existing technical processes, either of chemistry or application, involving as they always do the vested interests of proprietors who have expended much time and money in their cause. Our wish is to stimulate to useful sacrifices of time and talent those whose capability is unquestioned, and those who have never fairly tested their powers, or have preferred to rely upon the monotonous, all but automatic sources of supply, open to the current goldsmiths trade of this country.

If the admirable combinations of enamels, with the technically imperfect gems of the Renaissance, constituted the delight of the exalted few who could possess them, and, to this moment, continue to be more eagerly competed for than any other class of precious relics, why should we despair of successfully founding upon them others as beautiful. Are we not backed by infinitely greater facilities, in every sense of the word, and by appliances, which had they existed in the 15th century, would perhaps have rendered our task hopeless.

Few, indeed, of our skilled craftsmen are artists by intuition, in spite of the golden opportunities afforded by South Kensington, with its unrivalled exemplary museum, its schools of art, and numerous beneficent dependencies. The valuable opportunity, therefore, now presenting itself to the Applied Art Section of our Society for encouraging competition by the skilled workmen, doubtless, will be heartily responded to, and may be confidently expected to confer a lasting benefit, firstly upon the operatives themselves, and next upon their employers. The primary condition of such competition, it goes without saying, should be purity and originality of conception, based upon the characteristics of a given school, accommodated with taste and judgment to modern purposes. It would be well if such designs were capable of enrichment with the irreproachable gems of our age, and, if they tended, in many instances, by the combination of beautiful translucent enamel to develop this comparatively neglected branch of the goldsmiths' art in England, encouragement in which, especially in the experimental sense, has absolutely depended upon one or two recognised masters only.

For myself, I may say that I have never ceased striving in that direction since 1862, although I have been annually reminded that the result of each year's labour, from a purely commercial point of view, could not have failed to be much more remunerative, had the similar amount been expended in the production of inartistic, mechanical ornaments, repeated *ad nauseam.*

The "Applied Art Section" needs by its labours equally to enlist the sympathies of workmen and employers, for is it not conceded under the only possible conditions of a great art industry, dealing with gems, and, therefore, inseparable from the consideration of capital, that the enterprise protecting and directing skilled labour into proper channels, is of far greater importance to

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the general community than the instrumental hand itself. For example, nobody suspects me, or other patrons of labour in a similar position, of creating, with our own hands, the art works which we call into existence. The educated master of this age, although he does not pass his life at the bench, according to the custom of his predecessors of the Renaissance, is, nevertheless, a technically practised man, who has been taught his trade in the workshop, and therefore knows what fine application is, and how to direct it. It would be both undesirable and impracticable for masters to sacrifice to manual labour time which, by the modern usuages of commerce, they are compelled to devote to business, to study, and to journeying over the principal portion of the globe, in search, as we have been, of fresh treasures of application, and the further development of our art.

In offering prizes, therefore, for the competition of skilled labour, due regard should be shown to the masters who have given rise to the skill of the competitors, who, in a word, have created the demand for their work. This may possibly be by means of an honourable diploma, acknowledging their share of service in the good cause, or any but a pecuniary distinction, which they would value little, and consider more fitly bestowed upon the competitors themselves.

I seek to demonstrate to you, from the archives of my own house—and you have seen it verified by Falize and other pioneers of art in gold, perhaps more strikingly than by the Castellanis, the immortal disciples of ancient crafts—that it is the duty of every intelligent master to embrace all the meritorious schools of design. In training the apprentice, it has always seemed to me indispensable first to improve his acquaintance with an art by patient and textual reproduction; but once the head and hand are accustomed to their work, to encourage—in preference to the servile copy of a jewel, however beautiful—the creation of those which, while preserving the purity of style, are yet original conceptions; in short, such works as, under equal conditions of gems and their manufacture, might have been carried out in their respective bygone centuries. The accommodation to our wear of the grand schools of the 15th and 16th centuries, whatever the temptation of archæological considerations, should not suffer the use of gems of inferior quality or primitive manipulation.

Pre-eminent, therefore, among the applied gems of the *cinque cento* is the lovely but perishable pearl, the sole unaided gem (if gem it should be called), the solitary example of skin-deep beauty, incapable and gloriously independent of improvement at the hands of man.

Goldsmiths as a class, not only in this country, but also in France and Italy, appear to be growing unmindful of a great precept of the Renaissance, reposing in *them* the responsibility of creating taste for jewels of particular schools, which, alas! for want of a general determination, an understanding—in a word, a confederation of art and artists—are allowed, with all their valuable teachings, to lie dormant, or only to be regenerated by a very few of their number, in the cause of the small constituency, always faithful to art, and, like its great patrons of old, incapable of cherishing such glaring misapplications as bid fair, once more in our annals, to usurp the lead. All praise to our chairman to-night, and those with him, who first conceived the necessity for our Section of Applied Art, which embodies, as a pledge of success, the expert commercial element always ready, under the auspices of this Society, to assist in the furtherance of British art and commerce.

At this moment of universal depression in the staple trades of our country, of such giant industries as, in proportion to their own prosperity, are capable of reflecting either joy or sorrow upon the arts, and especially upon those arts of luxury to which we are now addressing ourselves. It cannot too well be understood, nor too fearlessly asserted, that English hands can and do produce as fine work as money can procure in any part of the globe. English workers are those, at any rate in connection with this trade, who most readily adapt

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themselves to work of a new or experimental character. Under such few of the masters as are encouraging them to depart from the beaten track, they are already adapting themselves to work which, ten years ago, would have been declined by them as the province of specialists abroad.

I am proud, as an Englishman, to say of the applications which are before you now, that they are initially conceived and carried out at home, and that sounder and better work could not be produced.

Having said, on behalf of my workmen, that which I am entitled to say, I beg leave to abandon to your competent judgment the outcome of my conceptions. It is deeply to be regretted, notwithstanding our advanced appliances in all branches of these trades, that whereas unlimited amounts of money are forthcoming for the purchase and preservation of the goldsmiths' work of the cherished centuries, not even an attenuated proportion of the sums so expended is now applied in pure encouragement of art in gold.

The pleasing exception, whether as a result of trade depression, or the apathy of art patrons, is to receive the commission to execute a fine work of art in gold, of the jewelled and enamelled type, such as might be considered a diploma, and one of the monuments of a house subsisting as we all do upon reputations and skill. The purchaser of these days desires apparently to limit his acquisitions to such articles as may, by the enterprise of certain masters, be found in a state of readiness. Artistically speaking, this is as unfortunate for the buyer as the seller.

The goldsmith, feeling himself not only cramped in the field of his invention by the dearth of commissions, but seriously hampered by the capricious tyranny of fashion, naturally only provides such articles as in his judgment, good or bad, are likely to fine ready purchasers.

Sad is the reflection that the destiny of the goldsmith, both here and with our cultured neighbours of France, should be swayed by the fashions of a conspiracy of *modistes*, whose distorted conception of female adornment, by common consent, is allowed to sit in judgment upon a nobler and more enduring art. It is true that exaggeration of the size of jewelled ornaments has departed, I hope for ever; but, as a consequence of the *modiste*'s veto, we are threatened, for the present, with the absolute eradication of jewels from female adornment. Indeed, the proportions of such ornaments as are to-day admissible by the strict regulation of fashion, are such as seriously to endanger the proper expression of art.

The staple articles of present adornment are the brooch and the armlet, reduced, if one would slavishly comply with the dictates of fashion, to such meagre limits, that a fair opportunity is not afforded the designer of expressing either the style or detail of his art. Earrings, for example, after thousands of years of unquestioned popularity, are menaced with nothing short of extinction. It is not an exaggeration to assert that there is not a single tradition of all the beautiful earrings, whether of Greek, Etruscan, Roman, or Renaissance origin, which can be reproduced in its entirety with any hope of popular sale.

Against better judgment, the goldsmith is compelled to trifle with his art by adopting, here and there, a section of the whole, so as to squeeze a semblance of the reality into the pitilessly small space allowed him. Bracelets of nearly all the antique types are at a proportionate disadvantage. But the despair of the artist reached its climax when the pendant was, for many years, ostracised by fashionable society. The graceful pendant, the veritable type of the goldsmiths' Renaissance, however often we may be forced to make a brooch of it, remains a pendant still. Happier days, at last, seem to be dawning for this most consistent jewel, now again reasserting its empire. Once more may the treasures of tradition be safely consulted, both the noble cap jewels and pendants of the Medicis or Valois, and the valuable legacies of Holbein, Zucchero, and Jehannet, those faithful translators of the goldsmith's skill. I have taken refuge in the royal and knightly collars of the Renaissance, wherein the grandeur of reposing art reflects much beauty upon imperfect gems.

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Even now, I am adapting them, as you see, to the throatlets of our dames and maidens, in the confident hope that, ere long, they must assert their superiority, as vehicles for gems, over those senseless perversions which offend consistency. The general history of the arts, even without especial reference to this important chapter, shows that the career of the true goldsmith, always beset by difficulties, was never more so than now. The plethora of the precious gems, offering perpetual temptation to abandon art in simple favour of gaudy phantasy, is a great but by no means insurmountable difficulty. There is no reason why a constituency, numbering the millions of London alone, viewed as the centre of the art industries of Great Britain, should not support the worthy schools of her goldsmiths as well as jewellers. It seems evident that, if they, as parties to the contract, will only adhere to principle, London will not fail to respond, more and more initiated as she shall be into the mysteries of the crafts, by the grateful influence of her technical schools and art societies.

I will not for one moment discourage the liberal application of precious stones to articles of personal ornament, but I would have them consistently dealt with. In the interest of the wearer, as well as the producer, more regard should be shown to form and meaning. Why should diamonds not be massed, unaided by enamels or gold, in many of the forms of the Renaissance? Surely their effect as gems would not suffer, and the jewels so produced should command more patrons than others, however beautiful the material, which were unsupported by conventional art. It is both impossible and undesirable to attempt to check the empire of the gems, which have become the ruling destiny of our art, and, therefore, a condition of its existence. To those who would say that the splendid gems of this century contributed in a measure to the disturbance of traditional composition, I would reply that if such gems had been available in the earlier centuries, undoubtedly they would have been employed, much in the same fashion as the imperfect stones of these periods. Even admitting that such applications, while preserving their artistic character, might to some extent have been modified with especial regard to the use of such a gem as our plenteous diamond (then only in a partial state of existence), the inexorable fact remains, and its observance is a condition of our continued prosperity; that the gems of this age have become a paramount consideration.

Gems must be lavishly employed in response to universal demand, but should be applied with more and more judgment; with more and more feeling for the decorative principle, if the modern goldsmith aspire to a share in the glorious traditions which have elevated his craft into an art.

The scope of my paper forbids my entering into the arts in gold as dissociated from gems. By any foregoing observations I must not, therefore, be understood to imply a want of veneration for an art so really beautiful that, were its principles more generally observed, would not only deserve, but reoccupy, a foremost rank in public estimation. I do perceive the unconquerable love of that which is sparkling in the perfection of modern gems. Natural inclination to gaudiness demands, therefore, unexampled discretion on the part of the goldsmith, whose aim it is to steer the course imposed upon him by the 19th century, with its inexhaustible supply of gems at last within the grasp of all classes of society.

Now that the gems are absolute, there is something of despotism in their sway, which warns the goldsmith that prosperity depends entirely upon their judicious application. Let us therefore conspire to train the workman to a tasteful exercise of these combined arts. Philosophically we shall grieve over the attenuation, if not in years to come the virtual disappearance, of unaided art in gold. When we have lamented that its staunchest patrons, possessed by fashion, are now untrue to their old allegiance, we must even so acknowledge the potent attraction of the gems, alluring us to departure from arts which had the reason of their being in the forbidding price of precious stones.

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I have said much in the cause of our craft, and of those who have upheld its dignity throughout many centuries, to the present day; but I should fail in the duty of a champion of the numerous British goldsmiths, who are honourable observers of principle in the manufacture of their wares, if I hesitated to say that the unjustifiable debasement of the precious metals applied to personal ornament, excepting only a few insignificant articles protected by the law, has grown to be a terrible abuse in this country. This practice, I am persuaded, has done more to check the development of our branch of British industry than all the causes of depression combined. By its agency an unfair competition has been allowed to arise between that which is fraudulent and that which, being of sterling quality, could, under paternal legislation, create for itself a market all over the civilised world.

The principled producer is absolutety beaten out of the market which he himself has created by the immoral trash tolerated and legalised by our defective law of Hall-marking. The want of a simple but stringent Act, compelling the Hall-marking of all articles of jewellery vended within the British dominions, is, firstly, inflicting ruinous injustice upon those manufacturers who, under the voluntary system, have never manufactured bad gold; and, secondly, has firmly implanted in the minds of foreigners frequently our markets, the conviction that all British wares alike are made of the *or anglais*, or debased gold, than which they do not know of a more damaging qualification. It would be found, without doubt, whenever the constituted authority elected to grapple with this blot upon our system of manufacture, that the heads of all the foremost houses were unanimous in the opinion that such a guarantee, both to Englishmen at home and foreigners abroad, would alone suffice to bring about increased prosperity in every department of the trade.

It has been my privilege, as an advocate of compulsory Hall-marking in Great Britain, to address reports both to the Indian Government and, some time back, to the Goldsmiths' Company of London.

I sincerely hope that the day is not far distant when we may look forward to such an enactment as will not only confirm the good quality of home manufactures, but check the importation from the Continent of vast quantities of rubbish, produced expressly for our markets, of a quality so vile that it cannot re-enter the countries of its origin.

DISCUSSION.

Mr. Leopold Pam said he had listened with very great interest to Mr. Phillips's able paper, and had learnt a great deal from it.

Sir William McCormack said he had listened to the paper with much interest, and was glad to hear about the beautiful things of which Mr. Phillips had spoken so eloquently and well. Precious stones, as they all knew, had exercised great fascination over all peoples and in all ages, and there was not much likelihood, if any, that these fascinations would diminish. He thought those present, after inspecting the beautiful things which had been brought together that evening for their entertainment, could say that, in their own case, these, fascinations were not likely to diminish.

Mr. Foster Graham thought Mr. Phillips had opened up a very wide field for consideration. The question of improvement, upwards or downwards, was very important to anyone engaged in the manufacturing industry. He rather dissented from Mr. Phillips's views as to trusting to the workmen for any special improvement, believing that it was to the employer in art industries that they must look for improvement, not merely in the goldsmiths' art, but in every kindred art. If the employer was not technically, practically, and artistically educated, his staff of workmen would never become art-workmen. That, however, was a question which he would leave for others more competent than himself to deal with. He was also deeply grateful to Mr. Phillips for the many suggested ideas which he had imported into his paper, and which, when reflected upon, could not fail to lead to much improvement.

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General Brine said he had been in all the countries alluded to by Mr. Phillips, and had seen most of the gems which had been mentioned. The missionaries, who were the forerunners of civilisation all over the world, generally got hold of the gems, which they sold to travellers in order to support their missions.

The Chairman said he should not wish the discussion to close without justifying his opinion that "the breastplate of Aaron," was of the nature of a zodiacal palladium. Josephus ("Antiquities of the Jews," iii. vii., 5, 6, 7) by implication, frankly admits it. But he (the Chairman) had come to this conclusion not so much from the study of old world books as from long acquaintance with the people of India, and their traditional arts; and no one who had lived familiarly among them could ever for an instant doubt the original talismanic, palladial, phalacterial, prophylactic, alexipharmic, or therapeutic character not only of all jewellery, but of all decorations. Coloured stones, beautiful flowers, and fine feathers are not used in India primarily for ornament, but because they are sacred to some god the wearer would propitiate for his or her antidotal defence. Our whole pharmaçopœia, including the British Pharmacopœia, has really originated in this way. The officinal plants were at first only 36; that is one for each of the 12 leading, and 24 subsidiary ("decani," "24 elders") constellations in the sun's path or "zodiacal" circle. In conformity with their number also, the human body was divided into 36 parts, and when men fell ill they gathered and used, not chemically and physiologically, but alexipharmically and therapeutically, some suitable preparation of the plant sacred to the divinity presiding over the limb of organ affected. Pharmacy means literally "enchantment," and "therapeutics, " the worships of the gods;" or cure by faith in the divinities of certain plants. Now that we have distilled them off as essences, and precipitated them as alkaloids, and can weigh and measure them out with the nicest exactitude, we despise "the prayer of faith," and even prosecute those who still put their trust in it. He was first led to suspect the zodiacal origin of "Aaron's breastplate" from its obvious resemblance to the Hindu and Buddhist talismanic amulet known as the *nava ratna*, or "nine gems." This famous amulet, which is universally worn in India and Burmah, refers in India, in a secondary sense, to the nine poets [cf: the Pleiades or seven tragic poets of the Court of the Ptolemies] of the Court of the mythical Hindu king, Vikramaditya, B.C. 57; but in its primary sense, the only sense in what it is understood by the Buddhists of Ceylon and Burmah, it refers to the seven planets, Saturn, Jupiter, Mars, Sol, Mercury, and Luna; the triform moon [cf: "the triple Hecate" Tergemina] being represented in it by three gems instead of one. In Burmah this amulet is always shaped as a conventionalised eight-leaved lotus flower, typifying celestially the octagonal heaven, and terrestrially the octagonal earth; and is invariably set with the same gems, viz., the sapphire representing Saturn; the topaz, Jupiter; coral, Mars; the ruby, in the centre, Sol; the diamond, Venus; the emerald, Mercury; and the moonstone, the waxing, the pearl, the full, and the catseye, the waning moon or Luna. In India, on the other hand, the *nava ratna*, or *nao-ratan*, is always represented as a square, in fact, as a horoscopic square, obviously its most ancient form; while the stones with which it is set vary in almost every province; for, and in consequence probably of its wide association with the "nine gems" of the Court of Vikramaditya, its planetary character has become very much obscured among ignorant Hindus; as that of the horseshoe ornament with its seven gems, so much affected by horsey men, has passed out of popular recognition among ourselves; and that of the combined circle and crescent-shaped brooch, with its five pendants, has been forgotten by the Arabs and Turks, although it has descended to them directly from the Chaldeans, who were the great inventors of astrological mineralogy, and, indeed, of all ouranographical symbolism, whether spiritual or material. The vault of heaven, the womb of nature, with its included constellationary life, and, above, all, the seven guardian

(*Continued on page* 206.)

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A—TABULAR STATEMENT of the TWELVE STONES of AARON'S BREASTPLATE (Exodus xxviii. 17—20), showing their Hebrew names, the different translations of them; and the corresponding Tribes of Israel; also the twelve signs of the Zodiac, and twelve foundation stones of the New Jerusalem (Rev. xxi. 19, 20), arranged in the sequence of the twelve breastplate stones and the corresponding tribes to which they are supposed to answer. The regular order of the Zodiacal Signs and stones, and of the foundation stones of the New Jerusalem, is shown by the numerals preceding them. The tribes of Israel are numbered under each:—1st, in order of birth (Gen. xxx. and xxxi.); 2nd, in order of motherhood (Exodus i. 2—4); 3rd, in order of blessing of Jacob (Gen. xlix.); 4th, in order of their "numbering" (Numbers i.); and 5th, in order of their encampment (Numbers ii.).

Rows of Stones.	Number of Stones.	Hebrew* Names.	English translation Bible A. V.	English translation. Bible R.V.—margin.	Josephus, Ant., iii., vii., 5.	Generally received—names Rabbinical.	Suggested translation. Geo. B.	Corresponding tribes of Israel.	Corresponding sign of Zodiac.	Corresponding Zodiacal stones.	Corresponding foundation stones of New Jerusalem.
1st or South.	1	*Odem.*	Sardius.	Ruby.	Sardonyx.	Carnelion.	*Carnelion* = Sard.	REUBEN.‡ 1.1.1.1.4.	6. Virgo.	6. Carnelion.	6. Sardius=Carnelion.
	2	*Pidtah.*	Topaz.	Topaz.	Topaz.	Topaz.	*Chrysophrase topaz.*	SIMEON. 2.2.2.2.5.	10. Capricornus.	10. Ruby.	10. Chrysoprasus
	3	*Bareheth.*	Carbuncle	Emerald	Emerald.	Emerald.	*Lapis lazuli.*†	GAD. 7.11.8.3. [Levi] 3.3.3.0.0.	2. Taurus.	2. Sapphire.	2. Sapphire, or Lapis lazuli.
2nd or East.	4	*Nophek.*	Emerald.	Carbuncle.	Carbuncle.	Ruby.	*not* Emerald.	JUDAH. 4.4.4.4.1.	5. Leo.	5. Onyx=sardonyx.	5. Sardonyx.
	5	*Sappir.*	Sapphire.	Sapphire.	Jasper.	Sapphire.	*not* Sapphire.	ISSACHAR. 9.5.6.5.2.	9. Sagittarius.	9. Topaz.	9. Topaz.
	6	*Jahalom.*	Diamond.	Sardonyx.	Sapphire.	Diamond.	*Jasper ? not* Diamond.	ZEBULON. 10.6.5.6.3.	1. Aries.	1. Jasper.	1. Jasper.
3rd or North	7	*Leshem.*	Ligure.	Amber.	Ligure.	Jacinth.	*Aquamarine* (or *Beryl*).	DAN. 5.9.7.10.10.	8. Scorpio.	8. Aquamarine=Beryl.	8. Beryl=Aquamarine
	8	*Shebo.*	Agate.	Agate.	Amethyst.	Agate.	*Amethyst.*	ASHER. 8.12.9.11.11.	12. Pisces.	12. Amethyst.	12. Amethyst.
	9	*Achlamah.*	Amethyst.	Amethyst.	Agate	Amethyst.	?	NAPHTALI. 6.10.10.12.12.	4. Cancer.	4. Emerald.	4. Emerald.
4th or West.	10	*Tharshish*	Beryl.	Chalcedony.	Chrysolite.	Chrysolite.	*Chrysolite, ie., "catseye."*	EPHRAIM. 0.0.0.7.7.	7. Libra.	7. Chrysolite.	7. Chrysolite.
	11	*Shoham.*	Onyx.	Beryl.	Onyx.	Sardonxy.	*Jacinth.*	MANASSEH. [Joseph] 0.0.0.8.8. 11.9.11.0.0.	11. Aquarius.	11. Jacinth.	11. Jacinth.
	12	*Jaspeh.*	Jasper.	Jasper.	Beryl.	Jasper.	*Chalcedony* (or Agate?)	BENJAMIN. 12.8.12.9.9.	3. Gemini.	3. Agate.	3. Chalcedony.

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* Of these names, *odem* means "red;" *bareketh*, "flashing" or "lightning;" *nophek*, "glowing,"—*i.e.*, carbuncle, "a little coal;" the rest are now meaningless. In all cases, the best clue to the stones really meant are the foundation stones of the New Jerusalem and identical Zodiacal stones.

† *Bereketh* is literally "lightning stone;" and as in the time of Moses it was the semi-precious stones that were most in vogue, I venture to identify the *bareketh* with *lapis lazuli*, the earthy-blue ground of which is flashed all over with lustrous metallic flecks and zig-zags.

‡ Josephus (Antiquities iii., vii., 5) states that the names of the twelve tribes of Israel were inscribed on the twelve stones of the breastplate in the order of the birth of the twelve sons of Jacob. This was possibly the orginal parallelism of the tribes and stones, but it must have been modified when the Levites were broken up as a tribe, and the tribe of Gad (the 7th in the order of the birth of their progenitor) took their (*i.e.*, the Levites) place in the mustering of the tribes (Numbers i.), and with it the *bareketh* as their representative stone on the breastplate. Then Issachar, 9th in order of birth, takes the 5th place in the order of mustering, and with it the *sappir* ascribed to Dan by Josephus; and Zebulon, 10th by birth, takes the 6th place, and the *jahalom*, ascribed by Josephus to the 6th born, the Naphtali. This rule of transposition fails, however, to explain the difference in the allotment of the remaining six stones among the remaining six tribes, as indicated by Josephus on the one hand, and, on the other accepted by Rabbinical tradition. The reason, probably, is that the division of the tribe of Joseph into the two tribes of Ephraim and Manasseh led to an arbitrary attribution of the 7th, 8th, 9th, 10th, and 11th and 12th stones to Ephraim, Manasseh, Benjamin, Dan, Asher, and Naphtali, respectively. Of these, Asher, transferred from the 8th place of birth to the 11th in the numbering, keeps his stone, *shebo*; and Benjamin, raised from the 12th birthplace to the 9th in the numbering, also keeps his stone *jaspeh*. But Ephraim, put in the 7th place in the numbering, does not take the *leshem* stone of Gad, but the 10th stone, *tharshish*, of Zebulon; and Manasseh, put in the 8th place, does not take the 8th stone, *shebo*, of Asher, but the 11th, *shoham*, of Joseph, for which there is obvious reason. Dan, brought down from the 5th birth place to the 10th in the numbering, does not take the *tharshish* of Zebulon, but the 7th stone, *leshem*, of Gad; Naphtali, brought down from the 6th birth place to the 12th in numbering, does not get the 12th stone *jaspeh*, of Benjamin, but is associated with the 9th stone, *achlamah*, of Issachar. This is inexplicable; but, after all, it creates a difficulty only in the case of three out the twelve stones of the breastplate. It might have been supposed that the supersession of Reuben as first of the twelve tribes by Judah, would have led to the appropriation of the *odem* stone to Judah; which would have completely harmonised the arrangement of the twelve tribes in their encampment with that of the twelve stones on the breastplate; but the tradition which ascribes the *odem* to Reuben, and the *jaspeh* to Benjamin, has never faltered, and may not be tampered with. It is remarkable that the encampment order of the tribes is, as would be said in India, right-handed; and of the corresponding stones in the breastplate, left-handed.

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(*From page* 203.)

planetary, and twelve guardian zodiacal divinities, is what is represented by the horseshoe, the *nava ratna*, and by the ark, and other similar symbols. The heaven above us is at once the celestial Mount Ararat, and the celestial ark which survives the deluge of time; it is the palladium and shield of the universe; and the horseshoe, and the *nava ratna* are magical images of it, that is talismans, and of the highest defensive and remedial advantage when worn as amulets, a word [cf: *hamal* "a bearer,"] which means a thing "borne" round the neck, arm, wrist, fingers, waist, or ankles, or on the head, or hung from the ears, nose, or shoulder [cf: *hamala* "a sword"]. "The breastplate of Aaron" was, in my opinion, just one of these amulets, only it was a zodiacal instead of a planetary palladium. Everyone will now admit that the description of the Heavenly Jerusalem, in the Book of Revelation [xxi. 19-20] is derived from Chaldean astrology. Anyhow it is not original, but taken from the far older Book of Tobit. In this description, which I have long wished Mr. Phillips to reduce to terms of jewellery, for it would make a magnificent and most eloquent brooch, the 12 stones of "the New Jerusalem" are identical with the 12 stones assigned from the earliest tradition to the 12 signs of the zodiac. The number 12, like 7, is still everywhere in the East talismanic, and always refers to the 12 signs of the zodiac, just as 7 and 9 do to the 7 planets; the sacredness of the number 9, however, has another and older origin also, in which it is associated with the number 10, namely, in the 9 solar—that is, 10 physiological, afterwards distinguished as lunar, months of 28 days each of human gestation. The physiological month of 28 days, and the physiological year of 10 months, were far older than the astronomical month and year, as was therefore also the sanctity of the numbers 9 and 10. The great difficulty presented by "Aaron's breastplate" is in determining the stones of which it was made up. They were most probably absolutely identical with those forming the foundation of "the Heavenly Jerusalem;" but this cannot now be settled, as the tradition on the subject has long been uncertain, and every translation of the original Hebrew names of the stones is in consequence altogether conjectural. This difficulty will be at once understood by a glance at the tabular statement A on p. 204. The next difficulty is in assigning the 12 stones—which we should always call by their Hebrew names—to the 12 tribes they are intended to represent. Josephus says that the names of the sons of Jacob were engraved on the stones, beginning with the *odem* of Reuben and ending with the *jaspeh* of Benjamin, in the order of their birth; but as will be seen from the tabular statement A, this does not correspond with the order of the generally accepted Rabbinical tradition. In dwelling on this difficulty, and considering that the breastplate was most probably a similitude of the heavens, like the *nava ratna*, and that the distribution of the 12 tribes in Palestine, like that of the 12 cities in each of the Etrurian States, might be on a horoscopic basis, he (the Chairman) sought the clue to this distribution in the order of the encampment of the tribes of Israel in their trines, as given in Numbers ii.*; the trine of the East being Judah, Issachar, and Zebulon; of the South, Reuben, Simeon, and Gad; the West, Ephraim, Manasseh, and Benjamin; and of the North of Dan, Asher, and Naphtali. All this is set forth in the following tabular view, B, of the 12 tribes of Israel, in the camp order (Numbers ii.*) showing its

* By counting the stones appropriated to the twelve tribes in the order of the tribes given in Numbers ii., but beginning with the south side, instead of on the east as in Numbers ii., and going round by east to north, and ending with the west side, we get the order of the stones in their four rows, as given in Exodus xxviii. 17—20. The order of the tribes in Numbers ii. is from east to south, and round by west, and ending with north. It will be observed that the three tribes who lost the privileges of their prior birth, *i.e.*, of Reuben, Simeon, and Gad [in place of Levi], are in the camping order of Numbers ii., relegated from the east, the post of honour, to the south; and that the six more favoured tribes of the twelve correspond in horoscopic position with the six diurnal signs of the zodiac, and the six less favoured tribes with the nocturnal.

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correspondence with the 12 signs of the zodiac in their quarterly trines (the diurnal trines East and West, and the nocturnal North and South), as elucidating the arrangement of the 12 stones of Aaron's breastplate (Exodus xxviii. 17-20), and its zodiacal symbolism. Here beginning with the south side, and reading off backward by the east and north to the west side, the Hebrew names of the 12 stones assigned by tradition to the 12 tribes, arrange themselves in four rows exactly in the order given in Exodus xxviii. 17-20. This explains the order of the stones therein given, and confirms the tradition which has always assigned the *odem* stone to Reuben and the *jaspeh* to Benjamin, the only two absolute identifications of the whole 12. It is to be observed also that the camp order of the tribe, when "registered" with that of the 12 signs of the zodiac in their trines, as a horoscopic square; that is with Aries, Leo, Sagittarius, on the East, the post of highest honour; Virgo, Capricornus, and Taurus, on the South; Libra, Aquarius, and Gemini, on the West, and Scorpio, Pisces and Cancer, on the North; it will be observed that this "registration" places Judah in the sign of Leo, "the Lion of Judah." Moreover, the six favoured tribes occupy the six diurnal signs; that is, the dominant tribes appropriated them to themselves; while the six other tribes are found in the nocturnal signs; that is, were relegated to them. Observing this, it is impossible, irrespective of anything further to go upon, to avoid coming to the conclusion that "Aaron's breastplate" was a four-square figure of the heavens,

B.

NORTH—LEFT HAND,
WATER, WHITE.

	✣	NAPHTALI (*Achlamah*) Cancer.	DAN (*Leshem*) Scorpio.	ASHER (*Shebo*) Pisces.	✣	
	MANASSEH (*Shoham*) Aquarius.				ZEBULON (*Jahilom*) Aries.	
WEST—BACK, AIR, BLUE.	EPHRAIM (*Tharshish*) Libra.	Diurnal	Nocturnal Trines.	Trines.	JUDAH (*Nophek*) Leo.	EAST—FRONT, FIRE, RED.
	BENJAMIN (*Jaspeh*) Gemini.				ISSACHAR (*Sappir*) Sagittarius	
	✣	SIMEON (*Pidtah*) Capricornus.	REUBEN (*Odem*) Virgo.	GAD (*Bareketh*) Taurus.	✣	

SOUTH—RIGHT HAND,
EARTH, YELLOW.

and specifically a zodiacal palladium; which was worn as an amulet, and used as an oracle, after the manner of Dr. Dee's divining crystal. He (the Chairman) felt so convinced of this that he would arbitrarily translate the Hebrew names of the breastplate stones by those of the foundation stones of "the New Jerusalem," as given in Revelations xxi., in every instance in which there can be no reasonable doubt of the tribe to which they appertain. There were, however, wider and deeper reasons for his holding this view. Recent anthropological and antiquarian research had taught us that the religious sentiment exhibits itself at first in those degraded forms of polytheism which have been

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generically described by ethnologists under the term of animism, and which include such developments as fetishism, ætavism, or the worship of ancestors, and phallicism, or the worship of the reproductive powers of nature. Among the Caucasian races this low animist worship of the visible world was gradually raised to the higher forms of nature worship, of which the two principal are sabaism and polytheism: Sabaism, so termed from the Hebrew *tsebaoth*, "armies," applied particularly to "the host" of heaven, astral and angelic, is the worship of the 7 planets, and 12 signs of the zodiac, and of the stellar bodies generally, and originated in the study of chronometric astronomy among the Chaldeans, who from the first incorporated with it the older phallic worship of their country. Its chief stronghold now is in China; but its influence is to be traced everywhere in the Old World, not only in the ancient paganism still surviving in popular superstitions and folklore, but in the abstrusest of modern ecclesiastical dogmas, for the Hebrews were altogether Chaldean by culture, if not in race, and in the sacred Scriptures handed down by them to their spiritual heirs in Eastern and Central Asia and in Europe, show themselves to have been inspired in every stage of their religious development by the supernatural conceptions and poetic imagery of Mesopotamian sabaism, which reaches its highest flights in the theologised astrology of the Book of Daniel and the Revelation of St. John the Divine. At first the Chaldeans would seem to have worshipped the stars generally and indiscriminately, and only gradually to have singled out the more remarkable "kenspeckle" constellations for special adoption, such as the Great Bear, the seven asterisms of which first gave to that number its immemorial holiness. Then, as they came more and more accurately to mark the succession of the months, and, later on, of the years, by the courses of the moon and sun, these ruling planets became successively the predominant deties of Sabism. But the Chaldeans did not only regard each separate constellation, and, indeed, each separate asterism, as a distinct divinity, they also conceived of the entire expanse of the starry firmament above, with the green earth lying outstretched beneath as a corporate God, one and indivisible; the Macrocosm of Pythagoras, which, as their ouranography became perfected on the basis of the existing zodiacal and planetary system, they, under the existence of the phallic ideas still prevailing universally in the East, figured as an immaculate virgin mother; as a fruitful tree planted by the river of eternal life; as a holy mountain, the mountain of the gods (*i.e.*, the celestial Mount Zion, Mount Meru, Mount Olympus, &c., having each its terrestrial counterpart on earth); and as a heavenly city (*Kronou tursis*, *flammantia mœnia mundi*, "the Heavenly Jerusalem," &c.). This imagery, which if not suggested directly by mural paintings or mosaics, could have been conceived only by one who was a born master of decorative design, has determined all subsequent religious poetry and symbolism, and much ecclesiastical doctrine in the West, and every traditional motive of the ornamental arts of the East and West. It may be said, indeed, that there is scarcely a coherent ornament in art which is not derived from the Chaldean symbolism of the "Tree of Life," and of the 7 planetary and 12 zodiacal gods; and more than that, from their actual graphic presentment by the Assyrians and Babylonians. The veneration attached to certain numbers has its origin in the same source. The 7-fold planets.

"The lampads seven
That watch the Throne of Heaven,"

let the Chaldeans to esteem the unit 7 as the holiest of all numbers. Therefore they established the week of 7 days, and built their temples in 7 stages. Therefore also the city of Ecbatana was surrounded with 7 walls; and the temples and places of Burma and China are 7-roofed. Therefore 7 stars were given to the Pleiades; and 7 rivers had to be found for Vedic India, and 7 hills for Rome, and 7 mouths for the Nile; and the world is said in the Bible to have been created in 7 days; the clean beasts to have gone into the ark in 7's; and Balaam offered 7 rams and 7 bullocks on 7 altars; and the children

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of Israel daily marched round the walls of Jericho for 7 days; and Elisha bade Naaman wash in Jordan 7 times; and under the Levitical law every 7th day, and 7th month, and 7th year, was sabbatical, and a succession of 7 sabbatical years was followed by the year of Jubilee, which brought the sabbatical cycle to completion. Hence, as Josephus distinctly states, the candlestick of the tabernacle of Moses was 7-branched; and in the Book of Revelation the churches of Asia, &c., are 7; and there are 7 Christian virtues, and 7 deadly sins; and 7 sorrows of Mary; and 7 journeys of Christ; and 7 divisions of the Christian day; and 7 champions of Christendom. Likewise 7 wise men of Greece; and 7 sleepers; and 7 wonders of the world; and 7 metals; and 7 precious stones; and 7 notes of music; and 7 nails in a horse shoe; and 7 cuts and guards in fencing. The 12-fold signs through which the sun passes in a solar year made the number 12 divine. Therefore the sons of Jacob are 12; and there were 12 loaves of shewbread, which Josephus explicitly states "denoted the year, as distinguished into so many months;" and 12 brazen lions, as supporters of the "molten sea" of Solomon's temple; and 12 lions on the steps of Solomon's throne; and in the Book of Revelations the New Jerusalem has 12 foundations and 12 gates; and the "Tree of Life" 12 manner of fruits; and the woman clothed with the sun and moon is crowned with 12 stars. It is to be noted also that there were 12 tables of the Roman law; and that 12 fasces were carried before the decemviri who administered them; and that on the 1st of March each year the 12 Salii, or "dancing" priests of Mars, arrayed in embroidered tunics, perambulated the streets of Rome, bearing the 12 ancilia or shields dedicated the temple of Quirinus by Numa, as the palladium of the eternal city. It has never before been suspected, but they were certainly a zodiacal palladium; and I find that the embroidery on the cloaks of the Salii, as seen on an ancient gem, commonly figured in dictionaries of Roman antiquities [*vide* Rich], represents the sea-horse of Aquarius, and another symbolical figure which is not specifically zodical is certainly constellationary. The "fratres Arvales" were also 12. The palladium of British liberty is a jury of 12 good men and true; and of old every English archer went into battle with 12 arrows in his belt, whence the saying:—"Every English archer carries [the lives of] 12 Scotchmen under his girdle." The right number of spokes in a cart-wheel is 12; and the hosiers' sign of a ram or lamb hanging from either a 12-spoked wheel, or a wheel with revolving legs for its spokes, is nothing but a similitude of the circle of the zodiac, with the sign of the ram represented in enlarged proportion, and naturalistically. Great reverence and awe also attaches to the occult power of the multiple of 7 by 12, that is to the number 84, which is still largely affected by the Hindus and Jainas, and in certain relations even by the Mahomedans of India. From the ear iest traditions of the Hindus, the *chaurasi*, or group of 84 villages, as a reduplication of the 84 constellations of the heavens, and analogous to our hundred or "cantred," has existed as one of the larger divisions of the land in Rajputana, the Panjab, and parts of the North-West Provinces. The 84 constellations are also represented by the *chaurasi* necklace of 84 beads, and by *chaurasi* palaces of 84 windows or columns, and in various other forms. The number 360 is also especially sacred among the Hindus, and Jainas, and Buddhists, because it is a multiple of the number of the 12 months of the year by the number (30) of the days of a solar month. Is it reasonable, then, to doubt that the number of the stones of Aaron's breastplate was suggested by the 12-fold signs of the zodiac; and that it was in fact the zodiacal palladium of Israel. But why he (the Chairman) had gone into the matter at such great length was because he most strongly desired to recover the long lost threads of traditional symbolism in the ornamental arts of the Caucasian races. He did not forget what the followers of Geothe were always saying about art being its own self-sufficient end, and independent of all moral aim. But in reviewing the subject historically, he found that the highest principle

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in art was the didactic: and that the attainment of beauty is only the inevitable result of the successful artistic expression given to the teaching thus sought to be conveyed. And the advantage of going back to historical symbolism was that the hopeless striving after novelty and invention was destructive of all successful artistic expression in ornamentation, and forbidding to the true artistic temperament; while, on the contrary, nothing renders the attainment of artistic effect in decoration so easy as the use of traditional and familiar motives; especially if used with knowledge, and not ignorantly.

"A thing of beauty is a joy for ever."

As to symbolism, again: at least 5,000 years of speculation on the subjects of highest interest to our human nature are focussed in such ornaments as the *nava-ratna* and other talismanic Eastern jewellery, and in the gala trappings with which English cart horses are led forth on May-day; and surely even perfected material beauty receives an added charm, if it also be significant of the spiritual beliefs, and aspirations, and duties, in which men have always found, and ever will find, the only life worth living.

In conclusion, the Chairman proposed a cordial vote of thanks to the reader of the paper.

Mr. Phillips, in reply, said that he rose with feelings of gratitude to return thanks for the kind reception accorded to him. He was proud to acknowledge that to his father's training he owed the measure of his success as an art goldsmith. To Sir George Birdwood, the chairman this evening, he likewise conveyed the fullest sense of his appreciation of the generosity shown in presiding over the present meeting. Sir George, who was one of the sponsors of Oriental Art, would forgive him for saying that he had come to regard him as his sponsor and mentor too in many knotty questions, which he had ever been ready to solve with him, in the cause Applied Art. To those who were, perhaps, unable to subscribe to some of his assertions, he would say that in such necessary divergence of opinion lay the true value of discussion. He had been most carefully in stating only such facts as could be sustained, while his assertions resulted from the practical experience of several generations.—*Journal of the Society of Arts.*

THE REDUCTION AND TREATMENT OF AURIFEROUS QUARTZ.

A lecture on the above subject, which is of so much interest at the present moment, was delivered at the Cannon-street Hotel yesterday by Mr. C. J. Harvey, whose intimate acquaintance with everything relating to the mining and treatment of gold is well known.

The chair was occupied by Admiral Sir Leopold George Heath, K. C. B.

The Chairman, in opening the proceedings, said that Mr. Harvey was a well-known expert; and there was nobody in the City of London who could give a more interesting lecture. Mr. Harvey, had been all over the world practising the art of getting from the ore its utmost value. It was often said that one ounce of practice was worth more than a ton of theory, and he would at once ask Mr. Harvey to proceed to business. (Cheers.)

M. C. J. Harvey, who on rising was warmly applauded, said: Gentlemen, in undertaking, at the request of numerous friends, to deliever a lecture on the reduction and treatment of auriferous quartz—a task of no small responsibility—I am aware that many persons would prefer what should rather be entitled a "Lecture on the Wynaad Gold Fields," with which my name has recently been a good deal connected. But, as I hope to show you later on, the subject of the reduction of Gold quartz is a matter of vital importance to those who are interested in Indian gold mines, since it is mainly on the application of the best and most suitable machinery and

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processes for the reduction of auriferous quartz that the profit of the Indian mines will really depend. Before, however, proceeding to the more technical part of my Lecture, I wish you to understand distinctly that I am not here to speak of any particular mining company. (Hear, hear.) I will not even mention any particular mine if I can avoid it, lest I should be supposed to puff it directly or indirectly, which would be quite foreign to our meeting here. I shall also only speak of the Wynaad gold fields, because I can do so from personal experience, which I have not had of the Mysore fields, of which, therefore, I will say nothing; but, at the same time, I beg that my silence may not be construed by any of you who are interested in them as casting any doubt on their probable value, while the processes of reduction are necessarily equally important to both. I do not propose to take up your time by a description of the geological features of the Wynaad district, or to follow any authority, learned or otherwise, in connecting the Devala of Wynaad with the Havilah of Genesis. Some sceptical persons assert confidently that the gold fields are a myth altogether, and to such and to others who doubt not, yet fear, I would only say, "wait and you will see." That a valuable gold field has been discovered, or, I should rather say, re-discovered, there can be no doubt whatever among those who, like myself, have examined it practically; but I must tell you candidly that much time and labour will be required to develop it thoroughly, and as the old proverb, "the more haste the less speed," applies particularly to the early stages of gold mining, I can only advise, and I do so most strongly, all who are interested to exercise a little patience, and allow the necessary work to be done methodically, which will be by far the cheapest course in the long run. (Hear, hear.) Speaking in a very general way of the great ranges of hills which form, as it were, the backbone of Southern India, you will remark, on a map, that about the latitude of Calicut it trends away to the East, and culminates in the higher mountain mass known as the Neilgherry range, and it is along this portion from the Vythery district (entered upon from below by the Tambracherry ghaut) to the Neilgherry peak that so far as is known at present veins of auriferous quartz and masses of quartz boulders are interspersed. The latter (where auriferous) have in all probability been thrown off some true reefs by convulsions of nature, but I need hardly remind you that all quartz is not necessarily auriferous, and those who invest in mining enterprise must be careful in discriminating for themselves between what is likely to pay for working, and what can only result in disappointment. The true fissure veins (which have come under my observation) are such, as with ordinary good management, can hardly fail to give handsome results, where they have the necessary advantages of water and timber, an abundant supply of clean water being absolutely necessary to the processes of reduction. I have thought it right to warn the public against over sanguine estimates of results based upon assays of small quantities of quartz, and that only actual crushing in considerable quantity can prove the value of a quartz reef. I think it more than probable that a reef in which free gold is visible, as well as combined with pyrites, will yield under the treatment I am about to explain to you by means of a working model, something like an ounce of gold per ton, some possibly more, others probably less, but a yield of half an ounce of gold, based on a moderate capital and cost of working, will yield a very handsome profit. (Hear, hear.) This Wynaad gold field, in common with all other gold fields of which I have had experience is likely to yield some prizes, and a good many blanks (and investors are generally shrewd enough to discriminate between genuine concerns which are likely to yield prizes, and false concerns which are like to result in blanks). I do not consider it necessary to dwell upon matters of detail, such as the question of labour, which can be left to directors and managers, but will proceed to the main object of my lecture (and assuming that we have obtained our auriferous quartz, I will show you how to extract the gold from it to the best advantage). I am sure you will agree with me that

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where it is possible to do so the investing public should be made acquainted with the nature of the operations in which they are interested, a knowledge of which would dispel many of the erroneous ideas which at present exist respecting the treatment of auriferous quartz. Animated by a desire to clear the way to a better understanding of the operations, I purpose taking you into my confidence and ask your attention whilst I endeavour to describe, in as brief a manner as possible, the system generally in use for the reduction and treatment of auriferous quartz, (assured that I shall be listened to with patience, even though you should not agree with my conclusion). It would occupy too much time were I to attempt a full description of the whole process of gold reduction, including treatment of what is generally known as pyrites. I must, therefore, ask you to bear in mind that the object of the lecture will be to explain the nature of the reduction and extraction of free gold only, without reference (to exceptional cases requiring a modification of the system or) to the pyritous gold, that usually deposited or enclosed with iron in the form of iron or arsenical pyrites, a description of which may form the subject of another lecture at some future date. (Hear, hear.) The extraction of gold from quartz is by no means an invention of modern date; it may, therefore, be interesting to glance at what has been accomplished by the ancient workers. Long before the discovery of gold in California was made known to the old world, thousands of dusky miners were engaged in different quarters of the globe in working quartz reefs and crushing auriferous quartz with the most simple appliances. In South-east Wynaad, India, very extensive native workings exist; shafts have been sunk and levels driven, and in some instances nearly the whole of what was once a mountain of quartz, or an immense outcrop, has been almost entirely removed. For the purpose of washing the auriferous surface deposits races were formed and water diverted to the sites of their operations, by which means acres of surface have been turned over and washed. Considering that the ancient miners must have possessed very imperfect appliances, the labour of breaking out the quartz, crushing it, and extracting the gold, must have been a very tedious operation. The only native representative of the gold miner in the Wynaad at this date is the Koroomber, little being known of the race of people who accomplished the work to which I have referred. An opinion prevails that they were either destroyed or died out years ago. For grinding quartz (which is first broken small), the Koroombers make use of two stones—the bottom one flat, the upper one round or nearly so, to (whilst being firmly held by both hands) a kind of semi-rotary and rubbing motion is given, the crushed materials being washed in a bowl of this description, which is a model of what the Koroombers use for washing gold. The shallowness of the bowl prevents any great amount being treated. They have a bowl of water standing by the side; and after agitating the stuff in the bowl, they use their hands to sweep off the heavier poritons, and when they approach the sedimentary portion the men carefully let fall drops of water, and presently you see the gold pure in the dish. But I think they lose a very large portion. Turning to Africa, we find the natives on the west coast, with few exceptions, all follow the occupation of gold mining, very extensive native workings, both in quartz and alluvial, bearing testimony to the vast amount of labour which has been performed. I have seen acres of ground on the west coast covered with small round shafts 12 to 14 feet deep, at which depth the ground was honeycombed, by removal of the auriferous gravel, reminding me of the dry shallow sinking in the early days of Victoria, Australia. For crushing quartz the same appliances are used as in the Wynaad, but this operation, as well as washing out the gold from the crushed material, is usually performed by women. This is a native African gold-washing bowl, in the use of which the women are exceedingly clever. These bowls are made of various sizes (out of solid wood), some being over 30 inches across. You will observe it is very different in form to the Koroomber dish.

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The women, in using this bowl, are, without exception, the most expert of any people I have ever seen in washing gold. They never touch the material with the hands, but trust to the water. I have seen gold so fine from this system of washing, that if you put your finger upon it you could not remove it from the hand. It is the prettiest process I have ever seen. In Australia and New Zealand the natives apparently were ignorant of gold mining or the value of gold, as I am not aware of any trace of native gold mining operations having ever been discovered. In Hungary and Northern Italy, where the Romans are believed to have mined for gold, there are extensive ancient workings, but little is known of their manner of working or how they extracted the gold from the matrix or quartz. Some few years after the discovery of gold in Australia the first stamping mill (of the most primitive construction) was erected, and, before quartz mining as an industry was well established, numerous inventions were patented for extracting gold from quartz, all of which were tried and abandoned for simpler and more effectivte plans. It would be impossible to describe all the processes invented for extracting gold; but a few may be mentioned. One was for smelting the quartz and obtaining the gold pure. Another proposed to melt the quartz by a powerful mirror or burning glass. Another plan was to introduce jet of mercury into a revolving cylinder containing a heated mass of fine-crushed washed quartz. Another was the construction of an enormous cast-iron roller many tons weight; by making this roller to travel backwards and forwrds on an iron table, it was believed hundreds of tons would be crushed daily. The disintegrator also was put to a practical test and abandoned. The Chilian mill retains its position, but only in the after process with the concentrates. During this time improvements were being effected in stamping, and about 1858 the revolving stamp was introduced, and is now used almost universally for the reduction of gold ores, producing results which no other stamp-mill has yet accomplished at a minimum of expense for wear and tear, and must be considered by far the best mill of its class which has yet been constructed, although many modifications are in use. There are thousands of people now-a-days interested in gold mining, who never saw a stamp-mill, or have any idea of the operation, ready to accept the statements of interested parties as to the merits of some invention, which, however promising it may appear on paper, has never been practically tried; nevertheless, it has the advantage of being cheap, and will do much more work than the stamps. In making this statement I have no desire to undervalue this effort which many investors and others have made to produce a more effective stamping-mill. To all interested in this subject, I say do not suffer yourselves to be deceived. It is not cheap or so-called portable machinery which is required for quartz crushing. If a mine is worth working, and the operation is to become a success, the machinery should be of the very best description and properly erected will prove the cheapest. For prospecting work, cheap portable machinery may be of advantage. The time may come when the stamps will be superseded; until then follow the surer method of ascertained facts, and make us only of proved machinery, paying a fair price for a stamping-mill, and on no consideration consent to the purchase of cheap untried machinery, especially if intended for use abroad. Would time permit, I could relate some curious experiences of my own about cheap machinery. Before leaving this subject, I would say a few words about the disintegrator (of which there are many varieties), by the use of which it is asserted that the hardest quartz is reduced to an impalpable powder; possibly so, but we are not told what become of the gold! If difficult to obtain from the matrix by the simple operation of stamping, how much more difficult must the operation become after passing through a disintegrator, unless the inventors have some special appliance for saving infinitesimal particles of fine gold. The pneumatic stamps, well adapted for the treatment of some descriptions of mineral, are not such as I would make use of for the reduction

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of gold ores. The latest invention is the elephant stamp, a useful machine, and being portable may be of service, but in its present form would not be a desirable mill to erect for a large reduction of works. I am of opinion this stamp may be greatly improved and rendered very effective. It may be as well to point out here that a perfect system of gold reduction and extraction embraces several distinct features or processes, each one requiring the greatest care and attention, and especially cleanliness, without which there will be losses, even with the best appliances. The tailings or waste should also be constantly examined and carefully tested in order to discover the amount of gold lost. The importance of this cannot be over-estimated or too strongly impressed upon those in charge of reduction works. It must, therefore, be obvious to everyone, considering the minute particles which have to be collected and the value of the metal obtained, that every detail of the operation should be carefully watched, and that the rough and ready method of treating auriferous quartz, which some people commend, cannot succeed. In ordinary crushing, the degree of fineness to which the quartz should be deduced must be determined by the character of the gold, some portion of which will remain in particles of the quartz sand, but with proper arrangement the amount lost will not be great. When the gold is exceptionally fine the treatment must be modified, but in either case effective arrangements for concentrating the sulphides from the tailings would save most if not all the free gold. The gold obtained in each part of the process of separation or extraction will vary with its character; if the gold is coarse a larger portion remains in the coffers, if fine the proportion decreases, and that obtained outside the coffers increases. When the quartz contains gold of average fineness (without use of mercury in coffers) the coffers may give 60 or 65 per cent mercury or ripple boxes about 23 per cent, blanket tables about 10 per cent. (Mr. Harvey here explained the construction and mode of working of the model.) This model has been specially prepared in order to give you an opportunity of forming your own opinion on what (in my idea) may be regarded as the most perfect system of stamp in use, the model is one-quarter size, and with the exception of a few minor details, represents the general arrangement for the reduction and treatment of auriferous quartz. Before describing the construction of the mill, use of steel, &c., and manner of working, let us consider what are the objects to be obtained by the use of this kind of stamping-mill. You will say to get out the gold. Well, admitting it is to take out the gold, but in what way, and in what manner is it to be obtained? The object of this machine is to obtain the free gold with the least possible expense, wear and tear. (Mr. Harvey then described the machine, which he said was made in three pieces to facilitate the transport. It was constructed with a view to economy and stability. A machine of ten head of stamps would send through three tons per head per stamp per day, or 30 tons per day in all. It would only require eight men to attend to it, and where the necessary power could be obtained the number of stamps could be easily increased. I now propose to describe the process of reduction, and to make the description complete I must draw upon your imagination to supply what is wanting in the model. And assuming that we have obtained our auriferous quartz, I will show you how it is possible to extract the gold to the best advantage. (By means of the model, Mr. Harvey very clearly explained the system of putting the quartz through the mill, and extracting the gold; and mentioned that so large a percentage of the gold was obtained in the first stage of the process that it was not necessary to touch the mercury box above once in twelve months.) My task is ended. It only remains for me to thank you for your kind attention, and trust the information I have given will enable you to form a better idea of the processes employed for the reduction and treatment of auriferous quartz. (Loud cheers.) If any gentleman would like to ask any question, or wishes for any information about the details of the model, I shall be happy to answer them.

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A gentleman asked the weight of the heaviest portion of the machinery?

Mr. C. J. Harvey: The weight of the heaviest portion is 2 tons. The weight of each stamp is 8½ cwts.

In answer to a question as to what "free gold" is.

Mr. C. J. Harvey said that free gold is what would be obtained if they pounded a sample of quartz and then washed it, when they would obtain the free gold. The pyrites in gold passed through the mercury, but were saved by the concentrating buddles, where they retained the sulphides containing the gold.

The Chairman: Do you put quicksilver in the stamp-boxes?

Mr. C. J. Harvey: No.

The Chairman said he was sure he should only be expressing the wishes of the gentlemen present in thanking Mr. Harvey for the lucid and interesting lecture which he had given. The subject was one which was very interesting at the present moment to a great number of Englishmen and, also English women. The success of many new mines depended upon the cost with which the ore taken out could be reduced, and the percentage of gold which could be got from the matrix. There were many mines working at a profit with only 4 dwts. to the ton, so it would be seen that the success of a mine would often depend upon getting the largest possible proportion of gold from the ore. Mr. Harvey's system differed from that with which he was acquainted, more particularly in having no copper plates over which the stuff passed after leaving the stamps, and it also differed in not putting quicksilver in the copper box and mixing it with a certain proportion of quicksilver. With those exceptions he believed Mr. Harvey's model was similar to the mills in common use in California.

The vote of thanks was carried by acclamation, and Mr. Harvey acknowledged the compliment.

On the motion of Mr. H. Tolputt, a cordial vote of thanks was passed to the Chairman for his able and courteous conduct in the chair, and the meeting broke up.

It may be added that there was a very numerous attendance, and amongst those present were very many gentlemen who have taken a leading part in the proportion of mining enterprise in the Wynaad and Mysore districts of India.—*The Financier.*

JEWELLERY IN INDIA.

It is comforting to find a portion of the Native Press of India attacking the Native tendency to convert gold into jewellery, and thus to hoard it and render it unproductive; but the comfort is somewhat mitigated when we find the advantages of the system overstated, and its disadvantages, or the advantages of the opposite course, of employing the gold in useful and productive works, understated. Thus, one of the arguments for the making of jewellery is that "it can always be pledged or disposed of. The market for its sale is never closed and never depressed." What a very dangerous fallacy this is appeared with most painful distinctness during the last great famine. So universal was the want of food that often the only purchasers that could be found for jewels were the extortionate and iron-hearted money lenders or grain merchants. Not only did jewellery fall in value in common with coin—for the precious metals in every form lost very much of their purchasing power—but in relation to money itself jewels sank in many places to less than a fourth of their value, and in some to an eighth of the same. Gold—to say nothing of silver—in the form of jewellery was very little in demand. The principal wearers of them, women and children, were dying off; so that much of the jewellery became useless for purposes of wear. And there was no marrying or giving in marriage; there were no festivities. In the years of the country's direst need gold as jewellery sank to between a fourth and eighth of its

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usual value, as represented in coined silver, because jewellery was not current; it was not a medium of exchange. And when it is remembered that even money fell to between one-fourth and one-sixth of its usual value as compared with food grains, it will be seen that the value of jewellery, as compared with that of food grains, fell to between one-sixteenth and one-forty-eighth part of its usual value. If in ordinary times a ryot in distress, by selling a small ornament, could procure fourty-eight measures of millet and feed his family for a fortnight, during the great famine, it might in some large villages and towns have procured him three measures of the same grain on which his family might have contrived to feed for two or three days with diminished meals; while in the smaller and more remote villages the same jewel could with difficulty procure him one measure of millet for a day's short commons. And men and women were often too weak to walk the five, ten or fifteen miles that would bring them to the slightly better market for their jewels. Furthermore, the great famine exposed the dimensions of another evil connected with jewellery, which is always known to exist, but seldom known to its full extent; and that is the frightful, indeed the cruel, dishonesty of many Native jewellers. They debase the gold given them, and make up the jewels of wretched metal; and where the jewels are supposed to be more or less massive, as in armlets, anklets, beads, &c., they use but a very thin sheet of the precious metal to cover a large quantity of lead, iron, or even lac. Ignorant rustics, therefore, who flatter themselves that they are hoarding twenty rupees by making up jewellery, often really receive from the jeweller only five rupees' value, sometimes much less than that. During a great famine, when ryots do not buy from one another, they bring their jewels to the traders; and these knowing once expose the cheat; and the poor ryot finds himself utterly bankrupt. This is why Native jewellers in the interior charge so very little as they do for their work. Indeed, in towns, workmanship appears to cost between four and five times what it does in the country; but when the fraud in the country is considered, town workmanship is often cheaper. This accounts too for the very extensive use of European coins as jewels. It is not simply that the coins are beautiful specimens of workmanship; for the gold could be put into better form for ornamental purposes; nor is it that the coins could be used again as circulating medium; for they are sufficiently affected by the addition of loops, &c., to prevent that; but it is felt that, if the gold were put into the melting pot, the chances are very greatly against its coming out purified, or anything like as pure as when it was put in. To leave the sovereigns, half-sovereigns, and French gold coins unaltered, therefore, is to leave proof, to possible purchasers of the standard of purity in the precious metal.

If then it can be urged in favour of converting money into jewellery that it escapes income-tax and can be re-converted into money, on the other hand it may be urged that it is unproductive and yields no profit; that it seldom fetches in ordinary time of need more than the value of the metal, so that the value of the workmanship is lost; that the metal is often of less real value than is supposed; and that in famine time it is immensely depreciated.

India is glutted with jewellery; and yet India presents so mean an appearance to strangers that they believe it poor. In other countries the wealth that here runs into jewellery would be employed to cherish life and improve morality. The country at large has most urgent need of better dwelling-houses. The want of these is the cause of much sickness, mortality and immorality. The same, though to a less extent, may be said of better clothing. It would considerably improve health as well as comfort, if better furniture—in many cases we should say, some furniture—were used. A very large amount indeed of sickness is caused by sitting and sleeping on thin mats spread on damp floors by going barefoot, and by deficient protection of the skin from chills. But barefooted, half-naked or nearly unclad dwellers in damp huts, destitute of any furniture but a few pots and mats, may be found wearing jewels of gold! And the

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right employment of the precious metal would not only give them better comforts, but afford employment to many poor. But to pass to higher matters, the hoarded wealth of rich Natives might immensely stimulate production, and the arts and manufactures; and above all stave off famine, and improve the trade of this country with the world, and indeed of the world itself. For what a derangement of the trade of the whole world it is that India withdraws from circulation and hoards away more than one quarter of the world's production of gold. Last year the world's production of gold was only about seventeen millions-worth; and of this India absorbed and withdrew from use between four and five millions! Must there be an irruption of barbarians—say a Russian invasion—to break up and scatter these useless, wicked hoards?—*Madras Mail.*

NOTES ON AURIFEROUS QUARTZ SPECIMENS FROM BALLARAT.

(*From the Ceylon Observer, March* 10, 1882.)

This is a representative collection of quartz, more or less auriferous, presented by the Ballarat School of Mines to the representative of the Ceylon Court. These specimens show the mode of occurrence of gold and its associated minerals from the district around Ballarat. They are well worthy the attention of all interested in gold in Ceylon. Ballarat is situated in the colony of Victoria, one of the richest gold-producing districts of Australia. The geological formation is chiefly metamorphic schist or slates of silurian age.

Our Ceylon rocks are metamorphic, in several parts schistose and no doubt of Palæozoic age.

In Victoria gold was first obtained from alluvium and then followed its extraction from the quartz rock. From this colony from 1851-65, no less than 30,422,591 oz. were exported to the value of £121,690,363. This passed through the Custom-house, and it has been estimated that nearly 4,000,000 oz. were sent away otherwise.

From 1868-78 the gold extracted from alluvium was over 6 million ounce, while that from quartz was over 6¼ million oz. There has been a steady decrease from the alluvial deposits; and from the quartz, the amount has not increased since 1877.

One nugget found at Ballarat weighed 184 lb. and was valued at £8,376 10s 6d.

SPECIMENS.

No. 1, 2, 3.—This is a milky white quartz veined over with mispickel (arseno-pyrites). Free gold is visible as granules and as plates amongst mispickel. This quartz contains 7 oz. to the ton. The reef is in metamorphic schist 200 feet from the surface and 1,400 feet above the sea level. Locality, Owen's river. In No. 2, the gold is more distinctly visible than in No. 1, and in 2 and 3 it is visible but sparingly.

[Mispickel (arsenical-iron-pyrites) is of a tin or silver white colour inclining to steel grey, crystallizing in rhombic prisms. Its composition is bisulphide and arsenide of iron. Generally from 30 to 36 % iron; 41 to 45 % arsenic and 18 to 21 % sulphur.]

No. 4.—This is a milky white quartz, very compact and less veined with mispickel than the preceding. Gold is distinctly visible. The yield of this is 1 oz. to the ton and the reef occurs in metamorphic schist. Depth 1,120 feet at 293 feet below sea level. Locality, Stawell.

No. 5.—Dirty white quartz of great specific gravity, full of iron pyrites which crystallizes in cubic form and faces often striated and of a pale brass yellow color. Note the difference between this pyrite and the former mispickel. No gold is visible. It yields 15 dwt. to the ton taken from a depth of 300 feet at an elevation of 1,600 feet above sea level. Locality, Gordon.

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No. 6.—A quartz of very loose texture, somewhat resembling a breccia of a reddish colour, due to iron. It is highly ferruginous with most brilliant irridescent hues, due to the films of iron oxide. One or two specks of gold are visible with a magnifying glass. It has a felspathic external surface. It yields 10 dwt. to the ton. Depth 250 feet; above sea-level 1,140 ft; locality, Sebastopol, Ballarat.

No. 7.—A dense flaky quartz, somewhat ferruginous with a considerable quantity of metal, viz., argentiferous galena and auriferous pyrites. Note the peculiar shade of pyrite differing from the brassy iron one. This specimen was taken from a depth of 60 feet at 90 ft; above sea level. Locality, St. Arnand.

[Galena crystallizes in the cubic form with a perfect cleavage. Its color is a lead grey with metallic lustre. Composition is sulphide of lead and a little sulphide of silver. If the silver is in sufficient quantity to be worth extracting it is termed argentiferous.]

No. 8.—A dirty white quartz, compact in texture, full of cavities with crystalline quartz. A little mispickel occurs. No gold is visible to the naked eye, but slight specks show with the aid of a magnifying glass. Yield 6 oz. to ton. Depth 240 ft.; above sea-level 1080; locality Ballarat.

No. 9.—A whitish looking quartz, somewhat glassy, with auriferous pyrites, a few specks of mispickel occur. Gold is not visible. Yields 18 dwt. to the ton and was taken from a depth of 1,200 feet and 300 ft. above sea-level. Locality, Clunes.

No. 10.—A white quartz, stained reddish by iron. A little chlorite is present. It has a curious mamimilated quartz surface on one side with an iron casing below. There is a peculiar tinge of iron which is very common in Ceylon quartz. Gold is distinctly visible. Depth 60 ft. at 2080 above sea-level. Locality, Daylesford.

No. 11.—Quartz of a milky white character with a slate-wall. Gold is distinctly visible on this slaty-wall along with a little auriferous pyrite. Depth 600 ft. at 1,200 ft. above sea-level. Locality, Blackwood.

No. 12.—Dirty white quartz with a beautiful mass of rock crystal, the crystals being a double hexagonal pyramid. A little arseno-pyrite is present, but gold is not distinctly visible. Depth 300 feet at 1,150 above sea-level. Locality, Ballarat.

Nos. 13 and 14.—Beautiful, white, milky quartz with auriferous pyrities, blende and galena. Free gold is very distinctly visible in both specimens along with the blende. (14 is a very rich specimen.) Depth 450 feet at 400 above sea-level.—Locality, Maldon.

[Blende or black jack crystallizes mostly in dodecahedrons; it is usually black or brown. Composition is sulphide of zinc.]

No. 15.—A whitish quartz, much stained with iron, causing it to look reddish. Gold is distinctly visible on the iron ore studded all over its weathered face. Depth 80 feet at 1,400 above the sea-level. Locality, Ballarat.

No. 16.—A bluish glassy quartz; very cavernous. Gold is distinctly visible in the caverns and on other parts. Depth 900 feet at 60 below sea-level. Locality, Stawell.

Chief points noticeable in collection:—

1. The great density of the quartz.
2. The compactness of the quartz except in 6 and 7 which show that compactness is not a necessary characteristic.
3. The general association with other metals.
4. The colour of quartz is nil in determining gold. If need not look warm, as has often been stated, for 11, 12 and 13, as far as general appearance goes are cold and decidedly hungry, destitute of caverns and destitute of other minerals. White is the prevalent color in this collection, stained variously with iron.
5. The quartz being in crystalline condition is not a sign of its containing no gold. See No. 12.

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6. The visibility of gold is worth nil for Nos. 1, 5 and 8, are rich in gold. It has recently been stated that assayers are of no use. We are told we must be able to see and judge by the eye as to whether a quartz reef will pay and that it is a poor tale to have it tested. However such statements are not worth much. If we see the gold and know that it extends in the quartz, we then know without assay that it will pay and its extraction may be at once begun with.

Assaying of fair samples is very necessary. There is not sufficient sight-evidence of many varieties of quartz to warrant gold being there in paying quantity. Even the rough amalgamation process, so commonly used by the miner is unreliable where the gold occurs with pyrites. Nor can the amalgamation process be successfully used for its extraction in such cases, *e.g.*, three samples of auriferous pyrites were operated upon not long ago.

(*a*) From Siberia which contained 100 grams to the ton.
(*b*) „ Venezuela „ 300 „
(*c*) „ California „ 150 „

The first yielded all its gold by amalgamation. The two others, both in the raw state and after roasting, yielded only insignificant quantities. From further experiments, it was inferred that the presence of antimony and arsenic prevent amalgamation.

The tailings of old mines are now being re-worked by the "Chlorine process" or by the still better method devised by Mr. W. A. Dixon. See "Directions for extracting gold, silver, and other metals from pyrites. *Proceedings of the Royal Society*, vol. 20."

Ceylon quartz is rather *too glassy* in appearance, and from many localities is *destitute of metal* of any kind, or having caverns either empty or filled with earthy matter. The pyrites are of too brassy a nature. However, we have quartz partaking of the character of Nos. 6 and 16 in Hewaheta and Ramboda. A somewhat similar quartz to 10 and 15 occurs in Balangoda and the district around.

In the Nawalapitiya district, we have a quartz partaking of the nature of 11, 12, 13, but no metal is visible. The mineral galena, mispickel and blende have not been recorded up to the present time as occurring in this island.

[The above specimens can be seen at the De Soysa Museum.—ED.]

THE MINERAL RESOURCES OF INDIA, AND THEIR DEVELOPMENT.

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I am not unmindful of the difficulty of the task which I have undertaken, namely, to endeavour to convey to you, within the limits of a short paper, a just conception of a very large subject which has manifold aspects. The more attention and the more time I have devoted to it, the more impressed have I been with the inapplicability to it of ordinary generalisations. Indeed, it may be said that any compressed statement of the facts must of necessity be untrue. It would be convenient, no doubt, to be able to characterise in a few words the values of the mineral productions of India, respectively; but what would or might be true of one part of the country would not be so of others. General statements have often been published, the effect of which has been, that a supposed rule has been applied unjustly to particular cases.

Few have attempted, hitherto, to bring together the information widely scattered in many publications, in regard to any single mineral production which is found in India; and thus the opinions sometimes expressed as to the value of the diamonds, the coal, the gold, the copper, or any of the other numerous products, are likely to have been tinged with the speaker's own particular local experience. You may often meet with one class of writers or speakers who refer to India as abounding, or being exceptionally rich, in valuable

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minerals; another class will tell you that the minerals of India are worthless. There is one class of newspaper writers who refer to the least known and almost unexplored parts of the country as being the richest in mineral wealth, but such confident statements have recently been surpassed by one where the author has ventured to state, that "the highest peaks of the Himalayas, under perpetual snow, without doubt contain enormous stores of mineral wealth, which only require the application of scientific knowledge for their development." We may, I think, justly be at a loss which to admire most, the confidence in his own assertion displayed by the writer, or his belief in the capabilities of science.

Nine years ago, my former colleague, Mr. W. T. Blanford, F.R.S., read a paper* on this subject, before your Society, and my acceptance of the invitation of the Council to re-introduce it to your notice has been given in consideration of the fact that in the period which has elapsed, much additional information has been obtained, and that of late years attention has been specially directed to the mineral resources of India.

Were I to devote the time available this evening to giving you an account of any one of the principal mineral products, I should not be able to do full justice to the subject; and this I say, having, on more than one occasion, attempted to do so without complete satisfaction to myself, before other audiences. Even the large volume I have written on the "Economic Geology of India" will be found to be only a brief *resume* as regards some of the subjects treated of; and the reading of it, in order to a right understanding, should be supplemented by free reference to the fuller reports on which it is based. Its recent publication, however, absolves me, I venture to think, from going into details in this paper.

Upwards of 2,000 years ago the mineral productions of India were regarded as being of considerable value and importance, for Megasthenes has written, "India has, underground, numerous veins of all sorts of metals, for it contains much gold and silver, and copper and iron, in no small quantity, and even tin and other metals, which are employed in making articles of use and ornament, as well as the implements and accoutrements of war." Ptolemy and Pliny, and a host of subsequent writers, have left on record facts of great importance and interest; and in the correlation of these facts with those acquired in modern times, I have met with a number of remarkable results and identifications, some of which I have not as yet had an opportunity of publishing.

It would hardly suit the present occasion to follow the classification of subjects adopted in the "Economic Geology." What has to be said may most suitably be arranged under the following headings:—(1.) Precious and Ornamental Stones; (2.) Fuel; (3.) Metals; (4.) Salt; (5.) Building Stones; (6.) Pottery Clays; (7.) Miscellaneous. It is to be understood, however, that some productions I have not included in any of the above classes, but these are of minor importance, and may be omitted.

PRECIOUS AND ORNAMENTAL STONES.

India has, it is needless perhaps to remark, enjoyed a wide reputation since the earliest times as being a land wherein all or nearly all kinds of precious stones were to be found. If the term India be applied in the largest sense, as including some of the adjoining countries, especially Ceylon, Badakshan, and Burma, the statement is true; but if India be narrowed down to the limits of the peninsula, then some doubt must be expressed as to the occurrence of particular species of precious stones. It is certain that in very early times there were marts in India to which European jewellers repaired, in order to purchase many varieties of precious stones, but where some of these stones were obtained is not so clear, and the vague references of travellers are often not of much practical aid; indeed, it often happens, even at present, that it is extremely

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* *Journal of the Society of Arts*, vol. xxi, p. 386.

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difficult to trace back to their original sources precious stones which have passed through many hands. All that can be said on the present occasion may be included under the following heads:—Diamond, amber, corundum, ruby, sapphire, spinel, beryl, emerald, garnet, lapis lazuli, turquoise.

In the "Economic Geology" fifty pages have been devoted to a correlation of the hitherto widely-scattered facts regarding the occurrence of the diamond in India. I have succeeded in identifying the famous diamond mines visited and described by Tavernier in 1665, and by other still earlier travellers. Their identity was much disputed 100 years ago, and since then they have been simply alluded to as being forgotten and past hope of identification. I have also, I believe, fully established the oft-disputed identity of the Koh-i-nur with the Great Mogul diamond, which was described by Tavernier, who states that it had been found 100 years before his time, at one of the abovementioned mines. Quite recently I have found a reference to apparently this identical diamond by Garcias ab Horto, who wrote just 100 years before Tavernier, or in 1565. These are but examples of the results which have followed from the reading of ancient historical notices, under the light thrown upon them by modern geography and geology. Even the old myth of the inaccessible valley containing diamonds, and the method of obtaining stones from it, described by Marco Polo, in the "Arabian Nights," and elsewhere, has been shown to rest upon a basis of fact.

The diamond-bearing tracts are situated in three widely separated regions, namely, in Madras; in the Central Provinces, with Chutia Nagpur; and in Búndelkhand. The geology of these is all more or less perfectly known, and it is possible to indicate roughly the limits of the actual diamond-bearing strata. That these have been exhausted is most improbable; and in spite of the large quantities of diamonds which have been taken out of the detrital deposits, it seems just to conclude that properly conducted operations would yield as many more, and by means of modern appliances, at a great saving of the amount of time and labour which was formerly expended. Under existing conditions in India, it may be doubtful whether it would pay to re-open these mines; but I am, on the whole, inclined to believe that the facts known regarding certain localities would justify systematic trials being made of the present productiveness of the mines and washings.

Amber.—This substance is not found within the British Indian territory, at least not in sufficient quantity to be of value; but in some tertiary coal-measures which are situated in the valley of the Hukung, in Upper Burma, there are mines which have been worked for a very long period. The amber which is obtained is in part carried to China by merchants, who visit the locality for that purpose.

Corundum, Ruby, Sapphire.—Although I have collected a number of ancient, and some comparatively recent, references to the existence of sources in India from whence the transparent forms of corundum—namely, ruby and sapphire—have been obtained, I am still inclined to believe that there have never been regular mines of either in India proper. The majority of the sapphires to be found for sale in India formerly, as at present, came, I believe, from Ceylon; and, in a similar manner, the rubies have been brought from the famous mines of Upper Burma. Corundum, however, is known to occur at so many localities in India, that the discovery of the mineralogically nearly identical ruby and sapphire, would not be surprising. Sapphires have at different times been reported to occur in the Himalayas. It is not inconceivable that it may hereafter be found profitable to export corundum from India to Europe, for manufacture into emery.

Spinel.—The spinel or *balas* ruby has been found, I believe, sparingly, in Southern India, but the principal localities where it has been mined for are situated in Afghanistan, Badakshan, and Upper Burma. Many of the famous and historical so-called rubies are now known to be only spinel.

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Beryl, Emerald.—There appears to be no record of the green variety of the beryl, which is known as the emerald, ever having been found in India. This gem, so highly esteemed by the natives of India, especially by the Mahomedans, is imported from the European markets. The pale-coloured beryl or aquamarine, is, however, obtainable in several parts of the country.

Garnet or Carbuncle.—The cutting of precious garnets which are found in many parts of India, *en cabochon*, appears to have been practised since early times, and there is, at present, a small export trade in these so-called carbuncles.

Lapis Lazuli.—The most famous mines of this stone are situated in Badakshan. It is not known to occur, though it is much esteemed in India.

Turquoise.—This stone, which is much worn by some of the Himalayan tribes, is of very doubtful occurrence in India. The supply, it is believed, comes from certain famous mines in Persia.

Many ornamental stones may be mentioned, as, for example, cornelian, jasper, agate, jade or serpentine. The first three are found in great abundance in parts of Western and Southern India. Their cutting and polishing constitutes a famed industry of great antiquity, and which still exists in certain regions. Jade is found, but not worked, in several parts of the peninsula. In native Burma and in Karakash, to the north of the Himalayas, there are famous mines of it. Serpentine is found at many localities, both in peninsula and extra-peninsular India. A very superior class of steatite, much used for carvings, is found in Rajputana, but upon it heavy royalties and other dues are levied.

METALS.

Omitting from consideration on the present occasion, the less important metals, of the presence of which more or less abundant indications exist in India, I shall limit my observations to a few brief remarks on the following—gold, silver, copper, lead, zinc, iron, and tin.

Gold.—Regarding gold, especially in reference to the position it at present occupies in the eyes of British capitalists, I regret that I am obliged to write very much as an outsider, as, although when last in India, I was most anxious to visit Kolar and the Wynaad, I was unable to do so. My opinion of these southern regions is founded upon what I have read and what I have heard; I am, therefore, not unnaturally reluctant to press it upon my present hearers. All who have any interest in the matter are aware that the testimony as to the extent of the auriferous character of the quartz reefs is of a most conflicting character. The value of this testimony is now about to be put, at great cost, to a test which must decide it one way or the other, and such large sums of money having been embarked in the enterprise, the time for giving opinions or making useful predictions has, in one sense, at least, passed away. Any attempt at generalisation from all the available facts would be of little avail, and specific information regarding particular properties is not at my disposal. In my "Economic Geology" I have given an account, based on all the information available to me when it was written, of the many and widely separated tracts in India where the presence of gold has indisputably been proved. In some of these tracts the mode of occurrence precludes the possibility of a plentiful supply, while, in others, the abundance can only be ascertained from operations which, from the nature of the case, must be costly.

That a vast quantity of gold has been raised from the soil of India has, I consider, been fully demonstrated by the amplest testimony; but when we attempt, by facts at our disposal, to estimate the time and labour which have been expended to produce that quantity, we may feel doubt as to the profitable character of the industry. I know of numerous regions in India, where the indigenous gold washers eke out a precarious existence by the practice of their profession. All experience, however warns us against attaching too much va to the bare fact of the existence of gold in alluvial depoits. It may in somee

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instances indicate the existence of a large supply *in situ*, close at hand; but the actual presence of that large supply requires absolute demonstration in every instance and cannot be assumed with safety.

Silver.—The fact that India ever produced silver in large quantity has hitherto been doubted by those who have expressed any opinion on the subject; but from evidence which I have obtained as to the abundance of a possible source of silver, I am inclined to accept literally, certain ancient and long-forgotten reference to its having been a silver-producing country. Argentiferous ores occur in many parts of the country, and some of them contain high percentages of silver.

Copper.—Copper ores occur in several of the older Indian formations, being sometimes found in regular lodes, but perhaps more commonly disseminated irregularly in the rocks which include them. As is well known, the latter mode of occurrence is not inconsistent with the presence of ore in sufficient quantity to be exploited with profit. In Southern India, in Bengal, in Rajaputana, in Afghanistan, and in the Himalayas, as well as in some other regions, copper ores were formerly mined to a large extent; this is amply testified to by the magnitude of the ancient workings, many of which were deserted long before they had a historian. The operations at others, of which we possess a record, gradually diminished under the influence of the fact that imported copper undersold the locally manufactured article at the very mines. At the present moment, copper mining and smelting is only carried on in a few remote valleys in the Himalayas and other localities. In the Nellore district, in Southern India, in Singhbhum, in Bengal, and in Kumaon, in the North-West Himalayas, attempts made to work the copper by European companies have not proved successful; but we should not, therefore, condemn the prospect which other localities might afford; nor would it perhaps be altogether just to accept as conclusive the operations which were certainly not conducted in all these cases with the requisite amount of skill. The failure by the natives, though in many cases due to actual poverty of ore, may, in some, be safely attributed to ignorance and to want of suitable appliances. The amount of metal manufactured bore but a small proportion to the amount of misdirected time and labour which were expended.

Lead.—With the exception of iron, there is no metal of which the ores appear to have been worked to so large an extent as have those of lead. The most common ore being galena, which is frequently more or less argentiferous, sometimes highly so, it seems probable that, as already stated above, the ancient workers devoted their attention, to the extraction of the silver rather than to that of the lead. It is certain, however, that in some of the localities, considerable quantities of lead were produced, as for instance, in Ajmir, where the mines were of great extent, and had, in 1830, the appearance of having been worked for centuries. The final closing of these mines took place in the year of the Mutiny, owing to a natural desire upon the part of the authorities to make lead for bullets as scarce and difficult to obtain as they possibly could. In peninsular India the ores of lead occur in the older geological formations, and the localities where more or less abundant traces are found are numerous and widespread. The remarks made above with reference to the exploitation of copper ores, might be applied, *mutatis mutandis*, with equal force to those of lead. The same causes have resulted in the abandonment of mining operations by the natives. In the Himalayas, not far from Simla, lead mining was carried on for some years by a British company, but the success met with fell far short of the anticipations of those who embarked in the enterprise, and the works are, it is believed, now closed.

Zinc.—Traces of zinc ores have been found in several parts of India; but at only one locality, namely Jawar or Zawar, in the Udepur State in Rajputana, have they been worked. The mines there were formerly of considerable extent, and the annual revenue derived from them is stated by Tod to have amounted to 222,000 rupees. The principal ore is Smithsonite or zinc carbonate, which

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was reduced in ingeniously contrived retorts. There are reasons for supposing that the same ore occurs in one of the Karnul galena mines, where it was probably treated as refuse, its character not being known to the native miners.

Tin.—Although ores of tin do occur in parts of the Indian peninsula, there is at present no evidence that they are anywhere of sufficient abundance to have been worked by the natives to any large extent; but in the native State of Bustar, in the Central Provinces, the inhabitants, it is believed, smelt a tinstone which is found there; and in the district of Hazaribagh in Bengal, about the year 1867, an attempt was made by an European to work a deposit of tinstone; but his operations not promising to be remunerative, were abandoned. The localities where tin ores are obtainable in Burma are very numerous. The majority of them are included in the strip of land in Tenasserim which extends from Yè to Maleewoon for a distance of about 400 miles. The sources of the stream tin, which is found in the majority of the rivers traversing this area, are situated in the range of hills separating British Tenasserim from Siam, and which continue south-wards into the Malayan regions, where, as is well known, sources of tin are abundant and prolific. In Northern Burma, and in the Shan States, other sources of tin ore are believed to exist. The working of the Tenasserim ore is carried on by scattered colonies of Chinese, Shans and Burmese, and appears to pay them well; but an attempt made a few years ago by a British company, at Maleewoon, to work according to European methods, terminated speedily with loss.

It is worthy of remark that in the "Periplus of the Erythrean Sea," which was written about 1800 years ago, tin is stated to have been exported from Egypt to the ports of Western India, though it was known then to occur in other parts of India (? Burma and the Malayan countries).

Iron.—During the 13 years from 1867-68 to 1879-80 inclusive, the total value of the iron imported into India by the general trade amounted to 156,210,253 rupees, or at par exchange, say, £15,621,025. In other words, the annual imports during this period averaged in value upwards of £1,200,000. As the average imports by Government for the years from 1873-74 to 1877-78 exceed 120,000 tons, the value may be set down, perhaps at from £500,000 to 600,000; but this statement is to be understood as being subject to correction, since the full figures are not before me. Taking into consideration the large imports of the last few years, it is very probably an under estimate. It is for our present purpose sufficiently apparent that India consumes, and has to pay for, very large quantities of iron, and what we have to consider is, whether any considerable portion of the requirements might not be supplied from indigenous sources.

I cannot here attempt to give even a sketch of the wide distribution of all the different ores of iron which are found in India, nor is it possible, within the space and time at my disposal, to trace the histories of the various efforts which have been made by British companies to establish the profitable manufacture of iron at several widely separated and differently circumstanced localities. The process of iron manufacture, as practised by the natives, has much connected with it, of both historical and technical interest, which constitute it a not unprofitable subject for study by itself; and much might be suggested with reference to the improvement and development of that process.

The costly experiments which have been made by companies have served to prove several facts, of which the principal are—*first*, that materials suitable for the manufacture of excellent iron do exist; *second*, that, while in some of the localities chosen, the manufacture could not possibly have been conducted with success, in others the conditions were more favourable, and that in consequence of the information so obtained no hesitation need be felt in the selection of the best of localities hereafter, should the industry be again started; *third*, that the iron produced at one locality will only be applicable to certain special purposes, and that from the sameness of the materials employed, iron,

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but of a limited number of varieties, can be produced; *fourth*, that the margin of profit upon local manufacture will, under the most favourable circumstances, be a very narrow one—so narrow as to be subject to be swept away with the oscilations in prices in the English market.' At the same time, it must be borne in mind that India is so large a customer of England, that a failure of demand from that quarter would certainly result in the lowering of English prices to a considerable extent.

It is my belief that a factory on a small scale could not possibly pay in India. It could not afford to keep up such an establishment as would provide for the carrying on of operations in the event of casualties, and from this and other causes, its operations would be subject to interruptions, which would be fatal to success.

Whether a colossal scheme of iron factories working in connection with one another at different parts of the country might not be successful is another matter to which attention may well be directed. It seems to be not improbable that had the Government started the manufacture of iron on an extended scale,* when the trunk lines of India were being opened up, great benefit would have been accrued to the State. That it would have been possible, politically speaking, for any Government to have done so continuously, may be doubted, owing to the opposing interests involved; but had there been a special department of the State—similar, say in its organisation, to the Forest or Salt Departments—it is certain that the effect of establishing factories for iron manufacture would have been to keep vast sums of money in circulation in the country, and to have given employment to large numbers of people who now crowd the land.

In a suitably officered department there would be a margin of officials, to allow for leave and casualties; and what is perhaps of more importance, the managers of individual factories would be upheld in their authority by a *prestige* which the managers of companies do not possess, and the want of which was a cause of incessant trouble at Bepur, Dechanri, and other places.

Whether a large scheme be ever undertaken by private enterprise or by the Government, the production of a variety of classes of iron should, if possible, be attained. Not only should the factories be able to turn out good qualities of rails and bar, but by producing an easily malleable iron, such as that made in the simple charcoal furnaces of the natives, and which commands a very high price, the use of iron in the interior might be largely extended, and an important industry created.

Of other metals found in India, besides those above mentioned, the most important are platinum, cobalt, manganese, and chromium. The occurrence of mercury is doubtful. Regarding what is known of these and a few other rare metals, full particulars will be found in my volume.

POTTERY CLAYS, &c.

The pottery clays most commonly used in India are of the coarsest kind, and the ware prepared from them is baked at a low heat. In certain parts of the country finer and more refractory clays are used for special varities of pottery. And there can be little doubt that were the occasion to arise, clays of high quality would be forth-coming. There is at present one European pottery in Bengal, the work turned out by which demonstrates the excellent quality and variety of the materials which are obtainable in the vicinity of Raniganj. Good fire-clay is obtainable, it is known, by actual trial in several parts of the country, and would probably be found in other parts should occasion for its use arise.

MISCELLANEOUS.

Under this general heading I include a few of the many mineral substances not above mentioned, but which occur in India, and have a greater or less commercial value. These are, graphite, or plumbago, sulphur alum, mica, and asbestos.

* A half-hearted attempt made at Barwai, in the Narbada Valley, never reached a successful issue.

Graphite, or Plumbago.—Traces of this mineral occur in many parts of India, but owing either to impurity, or the scantiness of the deposit, the majority do not appear to have any real value. The most promising graphite is that which occurs in the Travancore State.

Sulphur.—The sources of sulphur in India are for the most part limited in extent, and are only sufficient to supply local demands. They are chiefly connected with the occurrence of hot springs. The most prolific sources are situated in regions too remote to admit of their product being brought into competition with imported sulphur.

Mica.—This mineral, which is popularly but incorrectly spoken of talc, is obtainable in quantity, and in plates of large size, in the Hazaribagh district in Western Bengal. There is at present a small export trade, principally to Germany, I believe. Mica is largely used, too, in India, for various ornamental purposes.

Asbestos.—So far as is known, the most promising sources of this mineral are situated either beyond the limits of British territory (*e.g.*, Afghanistan), or in localities difficult of access (*e.g.*, Garhwal). Small quantities are obtainable at more accessible localities, and in view of the growing importance and value of the substance, it would be well if those who may have the opportunity of doing so would direct their attention to the discovery of a plentiful supply.

Statement of the Values of the Mineral Productions Imported into India during the official year 1879-80.

	Quantity.		Rupees.
Precious stones (including pearls)	...	...	...	1,552,799
Coal, coke, and patent fuel	608,760 tons	...	17,740,715
Petroleum	7,888,247 gals.	...	4,819,079
Sulphur	13,319 cwt.	...	11,290
Arsenic	300 "	...	5,256
Mercury	531,393 lbs.	...	588,436
Gold (including coin) ...	...	...	20,503,929
Silver	...	...	96,050,019
Copper	386,173 cwt.	...	16,201,547
Brass	10,279 "	...	538,484
Lead	73,480 "	...	1,062,958
Zinc	127,138 "	...	1,443,599
Tin	20,840 "	...	988,459
Iron*	2,111,156 "	...	12,293,847
Lime and chalk	43,739 "	...	19,294
Salt	353,238 tons	...	7,625,321
Saltpetre	3 cwt.	...	49
Borax	34 "	...	922
Building stones, mill-stones, grindstones, &c.	17,423 "	...	93,414
	Total	...	175,609,427

Or in sterling at par, £17,560,942 14s.—*Journal of the Society of Arts.*

NOTABLE GEMS.

A short time ago Messrs. Hancocks and Co., of Bruton-street, submitted to her Majesty a ruby which is accredited with being one of the finest specimens in existence, and known to be the finest in England, and not even excepting the crown jewels. Its history has not accompanied it to Europe, but as the experienced are well aware that even the famous mines of Baroda never

* Exclusive of imports by Government, the return of which is not accessible to me.

now yield gems of such size and splendour, they conclude that this must have been in the possession of one of the old Indian families. The owner's reason for parting with it remains a mystery, as Indians are usually very loth to allow such treasures to go out of their possession, and when they do chance to let them enter the market, purchasers are usually to be met with in their own country. The Queen is reported to have been much impressed by the beauty of this ruby. Its price of £10,500 is one at which a Crœsus might be supposed to pause. The stone is set as a medallion, and encircled by ten large diamonds.

The value of a ruby is greatly influenced by its colour, and this one is pronounced to be in that respect perfect. A necklet of the same precious stones inferior in size, but possessing the true pigeon blood shade, had each of these valuable gems divided by a cross of diamonds, while earrings carrying out the same design were in readiness to be worn with it. Another ordered for a bride was a simplified edition of this rich parure. In the last-mentioned, however, although £4500 represented its value, the rubies could not lay claim to the rich tint that so greatly enhanced the costliness of the former. They were divided by a rose of diamonds instead of a cross. An ornament likely to attract much attention is a collar of black pearls, from which depends a fringe of diamonds, and earrings to correspond.

The cat's eyes from Ceylon are peculiarly dark and lustrous, and, from the depth of their colour, bear a close resemblance to the onyx. They are richly set with diamonds, and adapted for either brooches or pendants.

For the pink pearls which Mr. Hancock exhibits he claims superiority both in colour and size over those on view at the Colonial Exhibition.

The shells in which these curious gems are to be found resemble the mussel rather than the oyster, and are to be met with in most of the West Indian islands. When both size and colour unite in one specimen the value is great, but if the former be without the latter the worth of the jewel is comparatively insignificant. In a pearl almost as large as a pigeon's egg the estimation is considerably diminished owing to the rose tint being deep in some parts, whilst in others it almost fades into white. Samples of greater value possess throughout that full colour which is seen in the center of a pink rose. A necklace in which these stones alternate with others of white, as well as with diamonds, is of indescribable delicacy and beauty.

Another costly ornament is a pendant of black pearls having in the middle a curious flattened specimen which is known as a "button" pearl of intense blackness, surrounded with eight cf its brethren placed in a knife edge setting. From this falls a pink pearl drop of perfect rose colour, weighing nearly 80 grains.

Lothair's "ropes of pearls" are to be found in many proportions, and claim attention both by their colour and the perfection of their symmetry.

American amateurs, who are so fully alive to the superiority of the treasures which the old Golconda mines used to yield, will be impressed by a case containing Indian diamonds of such transparency, colourlessness, and refractive power, as render them a thing apart. The case contains a complete parure including even clasps for bracelets. The setting is in the old style, and the stones are supposed to be of ancient date; indeed it is known that it is many years since the mines from which they have been drawn have rendered anything approaching them in size. The finest specimens, either from the Brazils or the Cape, will not bear a comparison with treasures such as these. Indian diamonds of any notable size rarely now find their way to England, and examples such as are exhibited in this case seldom cross the path even of those whose trade lies in this direction.

Limited space has only permitted the mention of the most salient features in jewellery, while many of the other treasures there to be found cannot fail to arrest the attention of visitors to the establishment.—*The Queen.*

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PEARLS:

THEIR ORIGIN AND HISTORY.

A home paper publishes the following interesting article on pearls:—

From oysters to pearls is a natural transition, though it be a change from pleasant aliment to pure ornamentation only. True, Marc Antony dissolved in vinegar and swallowed a pearl of fabulous value (£80,729 of our money), but we don't suppose that it proved a *bonne-bouche* for him or that his digestion was improved thereby. The pearl brings before us certainly another aspect of the oyster, "our placid creditor"—not as an article of food, but as an assistant at the toilet. The rough-shelled bivalve becomes a laboratory for the formation of what is universally acknowledged as one of the choicest gems provided by nature for the decoration and pleasure of Eve's fair daughters. "As your pearl in your foul oyster, says Shakspeare in "As You Like It," Act V., Sc. 4. For such is the lowly birthplace of the gem which has invariably held a high rank in the estimation of all, particularly the brunette, who will always look upon the pearl as the natural ornament of her style. An admirer, speaking of the pearl's delicate and silvery lustre, says, "It relieves the eye after gazing at the brilliancy of the diamond as the soft brightness of the moon after the dazzling fire of the sun." The Hindoos poetically ascribe the origin of pearls to drops of dew that fall into the shells of the fish in which they are formed. Pliny had probably heard of this idea, for he says, "Pearls vary according to the quality of the dew by which they are formed; if that be clear, they are also clear; if turbid, they are turbid; if the weather be cloudy when the precious drop is received into the shell, the pearl will be pale coloured; if the shell has received a full supply the pearl will be large, but lightning may cause it to close too suddenly and then the pearl may be very small; when it thunders during the reception of the drop, the pearl of the drop thence resulting will be a mere hollow shell, of no consistency." Augurello, an Italian poet of the thirteenth century, writes: "When the shells open on the surface of the deep excited by the genial season, they are filled by the light, fertilising dew thence in due time they bring forth their young, and the brilliant pearl is the ethereal produce."

But truth, especially scientific truth, is less poetic than fiction. Costly and lovely though they be, pearls are merely a calcareous production—a sort of morbid concretion found in many species of the class Mollusca—not necessarily in the oyster, therefore. The translucent pearl is only the outcome of a very simple law, namely, that in these animals the hard parts shall accommodate themselves to the soft. The oyster loves to be easy, and renders its bed soft and cosy, albeit its sheets, figuratively speaking, are wet ones. By its wonderful mucus it provides against inequality or irritation. Let some matter, say a dead embryo, cause internal worry, or a grain of sand external annoyance, and straightway it commences to cover over the evil with this calcareous exuvium, and, lo and behold! we get our pearls. This is even better than "out of the eater came forth meat," for, as Sir Everard Home says, "The richest jewel in a monarch's crown which cannot be imitated by any art of man, either in beauty of form or brilliancy of lustre, is the abortive egg of an oyster enveloped in its own nacre." This term is the scientific name for the exuvium, just spoken of; and if a pearl be examined by a good light through a strong glass, the concentric layers, like those of an onion, may be seen arranged round a very minute hole, wherein the ovum, grain of sand, &c., was first deposited. An ancient poet, in view of this, says, "For so much as the pearl is the product of life, which life from an inward troubled and sorrow and from a fault produces purity and perfection, it is preferred, for in nothing else does God so much delight Himself as in the tenderness and lustre of virtue born of trouble and repentance."

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We all know that beautiful substance so smoothly polished and exquisitely tinted which lines the shell and which is called mother-of-pearl, dyed with rainbow hues and possessing a glorious opalescence which, however common it may be, is charming to the eye. Dampier (a sailor with a poet's mind) says of this material, "The inside of the shell is more glorious even than the pearl itself." In structure nacre, or mother-of-pearl, is very dense, hard, and finely laminated, but the superficial outer layer is made up of small polygonal prisms, and is somewhat friable. The beautiful iridescent colours it exhibits are not the result of any inherent pigment, but are entirely produced by the action of light on the layers. Falling on these laminated plate-like surfaces, it is reflected along paths of different lengths, and thus all the prismatic colours appear. The colour of gem pearls is in general a bluish or silvery white; but they are met with of a variety of hues, transparent, semi-transparent, opaque, blue-grey, greenish, pink, red, brown, and even black.

Our own shores do not at present produce these jewels; but such was not the case formerly, for Roman writers inform us that British pearls were once held in such repute that Julius Cæsar presented a buckler covered with them as an offering to Venus Genetrix, which was suspended in her Temple at Rome. Some persons have suggested the introduction of the pearl oyster (Avicula Margaritum) to our banks again, but it is doubtful if we could ever again reap a harvest from the sea in this fashion. The pearl oyster itself is of no value, not being eatable, as its flesh is of a rank flavour and too tough for mastication. Pearls from mussels are less generally known. They are produced, however, not by marine, but by fresh-water species. For the best of these we must go to Scotland. Scotch pearls were much celebrated in the middle ages, and later still, between 1761 and 1784, pearls to the value of £10,000 were sent to London from the rivers Tay and Isla. We believe, however, that at present there is not much doing in Scotch pearls, though Mr. Unger, a dealer in gems in Edinburgh, some years ago said (1865), "It is now a fact that the beautiful pinkhued pearls of our Scottish streams are admired beyond the Orient pearl." Empresses, Queens, and Royal and noble ladies have made large purchases, of these gems, and he (Mr. U.) estimates the sum paid to pearl-finders in the summer of 1864 at £10,000, from Highland streams alone.

Attempts have been made to produce real pearls artificially, *i. e.*, to cause by means of art the growth of them in the fish. The Chinese were the first to do this, and still practise it, by placing very small beads of mother-of-pearl on a thread of fine silk and fastening them within the shells of the pearl oysters when they rise to the surface of the water in the beginning of summer. The fish are then replaced in their beds, where the beads are soon covered, as before mentioned, with calcareous excretions from the body of the animal, and do, in fact, become genuine pearls. A society for the prevention of cruelty to oysters would therefore not be out of place in China or Japan. In the latter country, by introducing little flat-stamped copper joss figures to the interior of the pearl-bearing mussel, the people obtain little pearl idols. Linnæus was well acquainted with the origin of pearls in general, was aware of the possibility of producing them artificially, and suggested the collection of a number of mussels, piercing holes in their shells with a fine auger to produce a wound, and afterwards "parking" them for five or six years to give the pearls time to grow. The Swedish Government consented to try the experiment, and long did so. Pearls were produced, but were of little value, and the enterprise was abandoned as unsuccessful, though Linnæus himself got a knighthood for the suggestion.

The pearl, like all jewels of lesser hardness, wears dim with time, and often discolours, or, as the jewellers term it, "dies." Various methods are resorted to in such cases for the purpose of restoring their original beauty, but they never recover their pristine splendour. In India they rub them with boiled rice; in some other parts they bake them in bread. Another stranger

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expedient is to feed chickens with them; then the animals are killed after two hours' time, and the pearls are rescued from their hiding-place, the action of the gastric juice having somewhat restored their colour. The true shape of the pearl should be a perfect sphere, or pear-shaped, like the celebrated monster pearl of the Great Mogul.

Not even excepting the diamond is there a jewel so often spoken of in history, sacred and profane, or so treated of in story or romance, as the pearl. In Sacred Writ, we have frequent mention of it and many of the ancient writers speak in glowing terms of its beauty. It has always been the type of purity, and the word has from time immemorial been used to illustrate whatever was pure and beautiful, and this especially in the language of the East, where such mouth-rounding names as Looloo, Mootoo, &c., represent it. Some pearls have become historic. Thus we read in an old play—

In good sooth,
If this the manner giveth not content,
Then may the matter, like the famous cup
Wherein old Egypt's Queen resolved a pearl,
The ransom of a kingdom, at a draught
Contain some stuff of value.

This refers to one of the two celebrated pearls possessed by Cleopatra—the other, saved from a similar fate, was slit into halves to form earrings for the statute of Venus in the Pantheon.

Julius Cæsar, in love with Servilia, the mother of Marcus Brutus, presented to her a pearl valued at six million sesterces (£48,417 10s. of our money). It was with a ring of pearl that the Doge of Venice wedded every year since 1177 the Adriatic Sea. Pope Leo the Tenth is said to have paid a Venetian jeweller £14,000 for a single pearl. We wonder if he had ever heard of the class of persons who and their money are soon parted. The traveller Tavernier purchased a pearl at Califa, which he is said to have sold to the Shah of Persia for the enormous sum of £180,000. If this be true, he was a lucky man, surely, to get out of Persia with his head on his shoulders. A Prince of Muscat possessed a valuable small pearl only weighing 12 carats, but it was so clear and transparent that daylight could be seen through it. He refused £4,000 for it. Perhaps a better proof of its value would have been that he had taken £4,000 for it. The pearl in the crown of Rudolf the Second, it is said, was as large as a pear. What pear? A Jargonel or a Duchesse? And how big was the oyster from which it was taken? The Shah of Persia actually possesses a string of pearls, each individual of which is nearly the size of a hazel-nut—an inestimable string of pearls. At the Paris Exhibition of 1855 Queen Victoria displayed some magnificent pearls, and the late Empress of the French exhibited on the same occasion a collection of four hundred and eight pearls, each weighing over nine penny-weights, and all of perfect form and the finest water. Here we must close our paper on

The priceless pearl,
Without the diamond's sparklings eyes,
The ruby's blushes—there it lies,
Modest as the tender dawn
When her purple veil's withdrawn,
The flower of gems, a lily cold and pale.

UNDERGROUND TREASURES: HOW AND WHERE TO FIND THEM. A KEY FOR THE READY DETERMINATION OF USEFUL MINERALS WITHIN THE UNITED STATES.

By James Orton, A. M.

Only those minerals are mentioned which are useful: any specimen, therefore, which does not fit any of the descriptions given, may be considered of

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no special value. By the term "color," is meant the color of a fresh fracture, for the exposed surface often misrepresents the true aspect. Exact color is not meant, but "red" stands for reddish, "yellow" for yellowish, "white" for a light gray up to the perfectly transparent. "Magnetic" means that the specimen disturbs the needle of a compass, or that a magnet will take up fine particles. A mineral is "opaque" if the light will not pass through either the edges or a thin fragment. A "translucent" mineral is either clear as crystal or only allows light to pass dimly through a thin portion. "Effervescence" is the bubbling produced by the escape of a gas, as in soda-water. "Gravity" is the weight compared with that of an equal bulk of water. In the majority of cases the specimen can be determined without it; but there may be several doubtful cases which can be settled only by obtaining the gravity. This is done by first weighing a fragment of the mineral in a small apothecary or jeweler's balance, reckoning it in grains. Then by a thread suspend it below one of the scales in a tumbler of water, taking care that the specimen is covered with water and does not touch the sides. Subtract the weight in grains as it hangs in the water from the first weight, and divide the first weight by the difference: the result is the gravity. Five per cent. should be allowed for impurities. Where exactness is not required, the gravity of a specimen may be judged by comparing it with well-known substances. Thus,

The gravity of anthracite coal is about	1.5
The gravity of brick is about	1.8
The gravity of clay is about	2.0
The gravity of marble and glass is about	2.5
The gravity of slate is about	2.8
The gravity of cast-iron is about	7.0
The gravity of copper is about	9.0
The gravity of lead is about	11.0

If the gravity of a mineral is 1.5, a cubic inch of it will weigh about 5-4 ounce; if 2., 1 oz.; if 2.5, 1 1-4 oz.; if 3., 1 1-2 oz.; if 4., 2 oz.; if 3, 2 1-2 oz., etc.

DIRECTIONS FOR DETERMINING SPECIMENS BY THE KEY.

HOW TO TEST MINERALS WITH THE SIMPLEST MEANS—PROSPECTING WITH A JACK-KNIFE AND COMMON SENSE—USE OF THE KEY—HOW TO TELL PYRITES FROM GOLD AND QUARTZ FROM DIAMOND—ALL THE USEFUL MINERALS GROUPED ACCORDING TO HARDNESS AND COLOR.

First see whether it will scratch common window-glass. If it will make the least mark, it belongs to division A; if not, it is to be found in group B. Next notice whether the light will shine through it: if it does not pass through even the edges or a thin splinter, it is opaque; if any light is allowed to pass it is translucent. With a knife see if it is harder or softer than pure white marble; then, noting its color, compare it with the descriptions of minerals referred to by the numbers. If it agree with none, it may be considered of no use in the arts. To make doubly sure, get the gravity as described above.

Examples: Suppose we have an unknown mineral in hand. We first try to scratch glass with it and find it impossible. It therefore belongs to section B. Next we find it is opaque and yellow, and evidently heavier and harder than marble. It must be one of two: 44 attracts the compass-needle, and this will not; it is consequently 26 or *Copper Pyrites*, if it agree with the description. If not, it is something of no great value.

You have found what you think is a diamond. Does the specimen scratch glass? Yes, easily, and is brittle. Can you see through it? You say it is clear as glass. Look now under section A, "translucent" series, number 6 (for it is colorless), and decide which of the four it is. The first one (27)

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is diamond; but do not let your wishes *make* it agree. Turning to the description, you read that it can not be scratched with a file or worn down on a grindstone. This decides against it. Besides, the gravity (2.5) is too little. With the next (57) it agrees perfectly, and you need not go further. Should the specimen, however, agree very well with rock crystal, only that its gravity (3.5) is too great, then it is topaz.

☞All minerals that scratch glass are brittle, and all (save 32 and 46) are infusible or melt with great difficulty.

☞The following minerals will burn, evaporate or melt without a flux in an ordinary fire: Nos. 2, 4, 5, 7, 10, 13, 14, 16, 18, 19, 21, 23, 24, 26, 29, 33, 35, 37, 44, 53, 55, 62, 63, 70, 71, 75. All but the following are heavier than marble: 2, 4, 6, 7, 10, 14, 16, 34, 36, 40, 47, 48, 56, 60, 61, 69, 71. Nos. 2, 50 and 58 alone dissolve in water.

☞In determining color, be sure you have a fresh surface, for the outside is often deceptive. By "blow-pipe" is meant the tapering tube used by watch-makers.

A.

WILL SCRATCH GLASS.

I. OPAQUE.	II. TRANSLUCENT.
(1) Black: 12, 20, 28, 30, 42, 43, 51, 54, 67, 72.	(1) Brown: 32, 59, 72, 77.
(2) Brown: 12, 28, 42, 59, 72, 77.	(2) Red: 17, 32, 46, 59, 68, 73, 74.
(3) Red: 39, 46, 54, 59, 67.	(3) Yellow: 32, 59, 72, 73, 77.
(4) Yellow: 38, 72, 77.	(4) Green: 74, 77.
(5) Gray: 22, 28, 72.	(5) Violet-blue: 3.
(6) White: 64.	(6) White: 27, 57, 73, 77.
	(7) Banded or clouded: 1.

B.

WILL NOT SCRATCH GLASS,

I. OPAQUE.

Harder than white marble.*	Softer than white marble.
(1) Black: 11, 35, 47.	4, 7, 10, 12, 13, 14, 16, 24, 34, 37, 49, 51, 55, 56, 76
(2) Brown: 66, 75.	12, 14, 21.
(3) Red: 44, 53, 75.	21, 23, 41, 55.
(4) Yellow: 26, 44.	12, 33, 56.
(5) Green: 45,	60, 61.
(6) Gray: 35, 66.	5, 24, 31, 34, 36, 49, 56, 63, 69.
(7) White: 6, 9, 11.	36, 40, 56 62.

II. TRANSLUCENT,

(1) Black: 11.	55.
(2) Brown: 9, 11, 65, 66.	48.
(3) Red: 9, 11, 18, 53, 78.	36, 55.
(4) Yellow: 9, 11, 15, 29, 47, 78.	48, 71.
(5) Green: 29, 45, 65, 70.	48, 60, 61.
(6) Blue: 8, 18, 29, 47.	
(7) Gray: 19, 47, 65, 66.	37, 69.
(8) White: 18, 47.	2.
(9) Mottled or Banded: 47.	

* That is, they are not so easily cut with a knife they do not necessarily scratch marble.

DESCRIPTIVE LIST OF USEFUL MINERALS.

THE GEMS—PRECIOUS METALS—VALUABLE ORES AND USEFUL MINERALS OF THE UNITED STATES FROM AGATE TO ZINC—THEIR DISTINGUISHING CHARACTERS, USES AND LOCALITIES—A MINERALOGY FOR MINERS.

1.—AGATE.

This stone is a mixture of several kinds of quartz, mainly the white, red, brown and black, disposed in layers or clouds. The layers are zigzag, circular or in straight bands (onyx). Occurs in irregular rounded masses; not very translucent; not altered by heat or acids; cannot be cut with a knife nor split into plates; takes a high polish; lustre glassy; gravity 2·5.

VALUE.—Used for jewelry and ornamental work, mortars, vases, knife-handles, burnishers, etc. The colors are deepened by boiling in oil and then in sulphuric acid.

LOCALITIES.—Found in granite and trap regions, generally by the shores of rivers, lakes and the sea.

2.—ALUM.

Occurs in mealy or solid crusts, often fibrous; dissolves in water; tastes sweetish-astringent; melts and froths up when heated.

VALUE.—Extensively used in dyeing and calico-printing, candle-making, dressing skins, clarifying liquors and in pharmacy.

LOCALITIES.—Found incrusting and impregnating dark slaty rocks, with yellow streaks.

3.—AMETHYST.

Same as *Rock Crystal*, but colored purple or bluish violet. Generally in clustered crystals.

VALUE.—When clear and finely colored, it is a favorite gem.

LOCALITIES—Usually found with agate.

4.—ANTHRACITE.

Occurs massive; compact; high lustre; brittle; breaks with a curved surface; will not scratch marble; burns, but not readily, with a pale blue flame and little smoke; will not form coke by roasting; gravity 1·4 to 1·8.

VALUE.—Used for fuel and sometimes cut into inkstands, etc.

LOCALITIES.—Found in beds between slates and sandestones.

The rocks in anthracite regions are tilted, bent and broken, never level to any great extent. Impressions of leaves are good indications.

5.—ANTIMONY ORE.

Occurs fibrous or granular; color lead gray, often tarnished; shining lustre, brittle; but thin pieces can be cut off with a knife; melts in a candle, at a high heat passing off in vapor; gravity 4·5.

VALUE.—The source of the antimony of commerce, containing seventy per cent.

LOCALITIES.—Found associated with *Silver*, *Spathic*, *Iron*, *Blende*, *Baryta* and *Quartz*.

6.—ASBESTUS.

Occurs finely fibrous, flax-like; flexible, not elastic; silky lustre, sometimes greenish; gravity 3.

VALUE.—Used for lining safes and steam-packing, and for making incombustible cloth, lamp-wicks, etc.

LOCALITIES.—Found in granite-regions.

7.—ASPHALTUM.

Occurs massive; brittle; breaking with high lustre like hardened tar, and with curved surface; melts and burns readily with flame and smoke; gravity 1·2, sometimes floats on water.

VALUE.—Used for cements and varnishes.

LOCALITIES.—Found generally near the surface.

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8.—Azurite.

Occurs in crystals and masses with glassy lustre, or earthy and dull; brittle; crackles and blackens, and finally fuses by heat; dissolves with effervescence in nitric acid; gravity 3·5.

Value.—A valuable ore of copper, containing sixty per cent.

Localities.—Found chiefly in lead and copper mines.

9.—Baryta, or Heavy Spar.

Occurs in crystals, plates and masses; powder white; brittle; crackles when strongly heated; not dissolved in acids; easily distinguished by its weight; gravity 4·5, or twice as heavy as *Gypsum*.

Value.—Used extensively as white paint and in pottery.

Localities.—Found in mining districts, often with lead, copper and iron ores, and in limestone.

10—Bituminous Coal.

Occurs in masses, beds or seams; softer and duller than *Anthracite*; often a bright pitchy lustre; brittle, showing a slaty or jointed structure rather than curved surface; powder black; burns readily with yellow flame; by roasting forms coke; gravity 1·5 or less.

Value.—Used for fuel and the production of gas, coke, carbolic acid and aniline.

Localities.—Found west of Harrisburg, Pa. in rocks (slates and sandstones) less disturbed than in the *Anthracite* region.

11.—Blende.

Occurs in crystals and masses; waxy lustre, but not always very apparent; usual color, rosin-yellow to dark brown; brittle; the powder, which is whitish to reddish-brown, dissolves in muriatic acid giving off the odor of rotten eggs; by roasting gives off sulphur-fumes; infusible alone, but on charcoal at a high heat gives off white fumes; gravity 4.

Value.—An ore of zinc (containing sixty-six per cent.) and a source of white vitriol. Often worked for its *Silver* and *Gold*.

Localities.—Found with lead and other ores.

12.—Bog Iron Ore.

Occurs in masses or beds, looking much like hard brown earth; loose or porous and earthy, rather than compact and nodular; powder yellowish-brown; when strongly heated becomes black and magnetic; gravity nearly 4. An earthy yellow variety is called *Yellow Ochre*.

Value.—An important ore, yielding thirty-five per cent.

Localities.—Found in low, marshy grounds; widely distributed.

13.—Brittle Silver Ore.

Occurs in crystals and masses; metallic lustre; tarnishes yellow, gray and finally black; easily cut or broken; when heated gives off fumes of sulphur and antimony, affording a button of silver; dissolved in nitric acid, it silvers copper placed in it; gravity 6.

Value.—A rich ore of silver, containing over sixty per cent.

Localities.—Found in veins with other silver ores.

14.—Brown Coal.

Occurs like *Bituminous Coal*, but usually brownish-black with less lustre, and often showing a woody or slaty structure; powder always brown; contains fossil plants; gravity between 1·2 and 1·5.

Value.—Inferior to No. 10. Makes no coke. Can be used in the manufacture of alum.

Localities.—Found in thin veins or elliptical masses, never in extensive layers.

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15.—CALAMINE.

Occurs in crystals and masses; glossy lustre; harder than marble; brittle; heated it swells up, becomes and emits a green light; dissolves, when powdered, in hot sulphuric acid without effervescence; gravity 3.4.

VALUE.—An ore of zinc yielding from forty to sixty per cent.

LOCALITIES.—Found in limestone rock with other ores.

16—CANNEL COAL.

Occurs in compact masses; dull lustre; brittle, breaking with a curved surface; burns readily but does not melt; does not soil the fingers; gravity about 1·2.

VALUE.—Used for fuel and for making gas, oil and ornaments.

17—CARNELIAN.

Occurs in masses or pebbles; at first grayish, but by exposure to the sun becomes uniform flesh, red or brown, never striped,—although *Carnelian* may form one of the bands of an *Agate*; brittle, breaking with a curved surface; very hard; takes a fine polish; glassy or resinous lustre; gravity 2·6.

VALUE.—Used for jewelry. When of two layers, white and red, (properly called sardonyx), it is used for cameos.

LOCALITIES.—Same as *Agate*.

18.—CELESTINE.

Occurs crystallized, fibrous and massive; color white, often faint bluish; glassy lustre; very brittle; under the blow-pipe crackles and melts, tinging the flame red; does not dissolve in acids; gravity 4.

VALUE.—The source of nitrate of strontia, used in fire-works.

LOCALITIES.—Found in limestone, gypsum and sandstone.

19.—CREUSSITE.

Occurs in crystals, in powder or masses; glassy lustre; brittle; dissolves in nitric acid with effervescence; heated strongly on charcoal, crackles and fuses, giving a globule of lead; gravity 6·4.

VALUE.—A rich ore of lead yielding seventy-five per cent.

LOCALITIES.—Found in lead mines.

20.—CHROMIC IRON.

Occurs in compact masses; powder dark brown; small pieces sometimes attracted by the magnet; brittle, breaking with uneven surface; with borax melts into a green globule; not acted upon by acids; little lustre; gravity 4·4.

VALUE.—Used in making the chrome pigments.

LOCALITIES.—Found in *Serpentine*.

21.—CINNABAR.

Occurs in granular or earthy masses; resembles iron-rust, but is a yellowish-red; powder scarlet; easily cut with a knife; thrown on red-hot iron, evaporates, giving off odor of sulphur; rubbed on copper, "silvers" it; gravity 9, or about as heavy as *Copper*.

VALUE.—The source of mercury (containing eighty-four per cent.) and vermillion.

LOCALITIES.—Found in slate and limestone rocks.

22.—COBALT PYRITES.

Occurs crystallized and massive; does not scratch glass easily; metallic lustre; tarnish, copper-red; powder, blackish-gray; brittle; heated on charcoal gives off sulphur fumes; heated with borax gives a blue glass; gravity 5.

VALUE.—An ore of cobalt, yielding twenty per cent.

LOCALITIES.—Usually found in slate or granite rocks with *Copper Pyrites*.

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23.—COPPER.

Occurs in irregular masses; metallic lustre; can be cut with a knife; malleable; ductile; fusible; gravity 8·8.

VALUE.—A source of copper and silver.

LOCALITIES.—Most abundant in the trap and "freestone" regions.

24.—COPPER GLANCE.

Occurs crystallized and massive; color, blackish lead-gray, often tarnished blue or green; nearly as hard as marble; brittle; a splinter will melt in a candle, giving oft the odor of sulphur; dissolved in nitric acid, it will coat a knife-blade copper; metallic lustre; gravity 5·5.

VALUE.—An ore of copper, yielding seventy-five per cent.

LOCALITIES.—Found at copper-mines.

25.—COPPER NICKEL.

Occurs in masses; metallic lustre; color pale copper-red; tarnishes gray to black; powder pale brownish-black; brittle; on charcoal melts giving the odor of garlic; becomes green in nitric acid; gravity 7·5.

VALUE.—An ore of nickel (containing forty-four per cent.) and arsenic.

LOCALITIES.—Found in granite regions.

26.—COPPER PYRITES.

Occurs in crystals and masses; color brass-yellow; tarnishes green; metallic lustre when freshly broken; can be cut with a knife; brittle; powder greenish black; on charcoal melts giving off sulphur fumes; dissolves in nitric acid, making a green liquid; gravity 4·2.

VALUE.—If of a fine yellow hue, it is a valuable copper ore (yielding from twelve to forty per cent.) and source of blue vitriol.

LOCALITIES.—Found in mountainous or granite regions with other ores.

27.—DIAMOND.

Occurs in crystals and irregular angular masses; cannot be scratched by any other mineral or the file; brilliant lustre; feels cold to the touch; when rubbed on the sleeve exhibits electricity for hours: retains the breath but a short time; often tinged yellow, red, or green; gravity 3·5.

VALUE.—Used for jewelry, lenses and for cutting glass.

LOCALITIES.—Found in gold-regions, in river-washings of sand and pebbles; usually with coarse gold, but deeper down.

28.—EMERY.

Occurs in granular masses, sometimes with bluish crystals; looks like fine grained iron ore; breaks with uneven surface; scratches quartz easily; very tough; brittle: gravity 4.

VALUE.—Used extensively as a cutting and polishing material.

LOCALITIES.—Found generally in limestone or granite with *Magnetic Iron Ore.*

29.—FLOUR SPAR.

Occurs in square crystals and in masses; glassy lustre; powder white; brittle; crackles when heated and then shines in the dark; does not effervesce with acids; is not scratched by marble; gravity 3.

VALUE.—Used as flux in glass and iron works.

LOCALITIES.—Found in limestone, granite, slate, etc., often at lead-mines.

30.—FRANKLINITE.

Occurs crystallized and in masses; generally made of coarse grains; brittle; powder dark reddish-brown; heated with soda turns blush-green; dissolves in muriatic acid; gravity 5.

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VALUE.—An ore of zinc.

LOCALITIES.—Found in limestone with *Garnet* and *Zincite*.

31.—GALENA.

Occurs in crystals and masses; brilliant lustre; brittle; easily broken; powder, when finely rubbed is black; can be cut with a knife; heated it gives off sulphur and melts; dissolves in nitric acid leaving a white powder at the bottom; gravity 7·5—or a little heavier than cast-iron.

VALUE.—The main source of lead (yielding eighty per cent), and also smelted for the silver it contains. Used also in glazing stone-ware.

LOCALITIES.—Generally found in limestone with *Iron Pyrites*, zinc-ore, etc. That found in slate is richest in silver.

32.—GARNET.

Occurs in crystals with four-sided faces; often nearly round; deep-red, which grows darker by heat; rarely yellow; also in brown masses; melts at a high heat; brittle; not scratched by a knife; glassy lustre; gravity 4.

VALUE.—The clear deep-red and yellow varieties are used for jewelry; the massive brown is ground for "emery."

LOCALITIES.—Found in slate and granite rocks.

33.—GOLD.

Occurs in scales, grains and nuggets, or disseminated through cellular quartz; metallic lustre; without tarnish; can be cut and hammered into thin plates; not dissolved by nitric acid; gravity 19, when pure and of a rich gold yellow color. The pale or brass yellow specimens are much lighter, the gravity being as low as 13. A grayish yellow gold, occurring in small, flat grains has a gravity of about 16.

LOCALITIES.—Found in veins of quartz running through greenish or grayish slates, the quartz at the surface being generally full of cavities and rusted, and the slates below the surface often containing little cubic crystals of *Iron Pyrites*: also in the valleys traversed by mountain-streams and in the river sands and gravel below. *Iron* and *Copper Pyrites*, *Galena* and *Blende* frequently contain gold. Masses of quartz and pyrites from the gold-regions, which make no show of gold, sometimes pay well; the value of such specimens can be determined only by an assayer.

34.—GRAPHITE.

Occurs in foliated, scaly and granular masses; can be cut into thin slices which are flexible, but not elastic; impressible by the nail; feels greasy; leaves a shining trace on paper; metallic lustre; not altered by heat or acids; gravity 2.

VALUE.—Used for pencils, polishing, glazing, for making steel, crucibles, overcoming friction, etc.

LOCALITIES.—Found in granite, slate and limestone rocks.

35.—GRAY COPPER ORE.

Occurs in crystallized or granular masses; metallic lustre; color between steel-gray and iron-black; brittle; the powder dissolved in nitric acid makes a brownish green solution; melts at a red heat; gravity 5.

VALUE.—An ore of copper (containing thirty-three per cent.) and silver, of which Nevada specimens have sixteen per cent.

LOCALITIES.—Found with gold, silver and lead.

36.—GYPSUM.

Occurs in plates, fibres coarse and fine, and massive; pearly or glistening, powder white, which if heated and mixed with water, turns hard; does not dissolve in sulphuric acid; may be scratched by the nail; gravity 2·3.

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VALUE.—Used for stucco, manure, glazing, statuary, manufacture of glass, etc. A variety, called *Satin Spar*, worked into necklace beads and other ornaments, is finely fibrous and compact, taking a polish (though easily scratched), and then resembles pearl or opal.

LOCALITIES.—Found with marl or clay, limestone and salt.

37.—HORN SILVER.

Occurs in crystals, wax-like masses, or in crusts; when scratched shows a shining streak; becomes brown on exposure; quite soft, easily cut; a small piece placed on zinc and moistened, swells up, turns black and shows metallic silver on being pressed with a knife; dissolves in hartshorn; gravity 5·5.

VALUE.—An ore of silver, yielding seventy per cent.

LOCALITIES.—Found in slate with other silver ores.

38.—IRON PYRITES.

Occurs in masses and square crystals; splendent lustre; color bronze-yellow; brittle; strikes fire with steel; heated, it gives off sulphur fumes; powder brownish; gravity 5.

VALUE.—Affords sulphur, copperas and alum. When found outside of the coal region, it often contains gold and silver.

LOCALITIES.—Found in all kinds of rocks.

39.—JASPER.

Occurs in masses, either in veins or as rounded stones; dull lustre, yet takes a high polish; breaks with a curved surface; not attacked by acids; is scratched by *Rock Crystal*; gravity 2·5.

VALUE.—Used for mosaics and other ornaments when compact, fine-grained and bright color.

LOCALITIES.—Found everywhere.

40.—KAOLIN.

Occurs in beds; it is a fine white clay, plastic when wet; when dry is scaly or compact; can be crumbled in the fingers and feels gritty; adheres to the tongue; does not dissolve in acids.

VALUE.—Used for the finest porcelain and for adulterating candy.

LOCALITIES.—Found generally with iron-ore and fire-clay.

41.—LENTICULAR IRON ORE.

Occurs in beds or masses, consisting of minute flattened grains; little lustre; generally soils the fingers; breathed upon has a clayey odor; color, brownish-red, powder more red; dissolves in strong muriatic acid with some effervescence; brittle; gravity 4.

VALUE.—An ore of iron yielding thirty-three per cent. Generally mixed with other ores at the furnace.

LOCALITIES.—Found in sandstone.

42.—LIMONITE, OR BROWN HEMATITE.

Occurs in masses, with smooth rounded surfaces and fibrous structure; sometimes as hollow nodules, which are velvety-black inside; its powder when rubbed is yellowish-brown; when strongly heated turns black; scratches glass feebly; brittle; dissolves in hot aqua-regia; gravity 4.

VALUE.—A common ore of pig-iron, containing sixty per cent.; used also for polishing buttons, etc.

LOCALITIES.—Found in heavy beds with mica-slate, quartz, limestone, etc.

43.—MAGNETIC IRON ORE.

Occurs in granular masses, coarse or fine; attracted by the magnet, or

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affecting the compass-needle; powder black; brittle; dissolves in muriatic acid; gravity 5.

VALUE.—An important ore, yielding sixty-five per cent.

LOCALITIES.—Found in granite, slate and limestone rocks.

44.—MAGNETIC PYRITES.

Occurs massive; brittle; deep orange-yellow; powder grayish-black; metallic lustre; tarnishes easily; slightly attracts the compass-needle; melts at a high heat, giving off sulphur-fumes; gravity 4·5.

VALUE.—Affords sulphur, copperas and nickel.

LOCALITIES.—Found in granite regions, often with copper and iron ores.

45.—MALACHITE.

Occurs in incrustations with smooth surface and fibrous; powder paler green than the mineral; brittle; by heat crackles and turns black; effervesces in acids; takes a fine polish, showing bands or rings; gravity 4.

VALUE.—Used for jewelry and inlaid work.

LOCALITIES.—Found in copper and lead mines.

46.—MANGANESE SPAR.

Occurs in masses; glassy lustre; color flesh or rose-red; becomes black on exposure; tough; melted with borax gives a violet-blue color: gravity 3·5.

VALUE.—Used in glazing stone-ware.

LOCALITIES.—Found in granite regions, often with iron-ore.

47.—MARBLE.

Occurs coarse and fine granular; frequently veined or mottled; brittle; can be cut with a knife; takes a polish; effervesces with acids; reduced to quicklime by heat; a gray variety contains stems and joints of worm-like fossils; gravity 2·5.

48—MICA.

Occurs in masses, which can be split into very thin, elastic leaves; pearly lustre; at a high heat becomes opaque; gravity 3.

VALUE.—Used for doors of stoves, etc.

LOCALITIES.—Found in granite regions.

49.—MICACEOUS IRON ORE.

Resembles *Specular Iron Ore*, but consists of thin shining scales or leaves; powder dark red; a thin flake is translucent, showing red light; feels somewhat slippery.

VALUE.—Used as an ore of iron and for polishing.

50.—NITRE.

Occurs in thin crusts, delicate needles, or disseminated through the loose earth on caves; glossy lustre; brittle; cool, saline taste; crackles and burns brightly in live coals; a little harder than *Gypsum*.

VALUE.—Used in the manufacture of gunpowder, fulminating powders, nitric acid, etc.

51.—OXYDE OF MANGANESE.

Occurs in masses and little columns, often with small rounded surfaces; one ore is soft enough to be impressed by the nail, and soils; the other will scratch glass faintly; heated with borax, makes a violet glass; dissolves in hot muriatic acid, giving forth a yellowish-green gas; gravity 4 to 5.

VALUE.—Used for bleaching and for obtaining oxygen.

LOCALITIES.—Found in granite regions, often with iron-ore.

52.—PLATINUM.

Occurs in grains or lumps; metallic, silvery lustre; can be hammered out; heavier and harder than silver; not dissolved in nitric acid; gravity 17.

VALUE.—Nearly equal to *Gold*. Used for making chemical and philosophical apparatus, for coating copper, brssa, etc.

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LOCALITIES.—Found in river-gravelled with *Gold*.

53.—RED COPPER ORE.

Occurs in crystals and masses; cochineal-red; powder brownish-red; nearly opaque; brittle; dissolves in nitric acid; heated on charcoal yields a globule of copper; gravity 6.

VALUE.—Affords copper (sixty per cent)., and blue vitriol.

LOCALITIES.—Found in trap regions with other copper ores.

54.—RED HEMATITE.

Occurs in compact masses, with rounded surfaces or kidney-shaped; fibrous structure; color brownish-red to iron-black; but powder invariably red; when black, the lustre is somewhat metallic, otherwise dull; brittle; scratches glass with difficulty; dissolves slowly in strong muriatic acid; gravity 4.5 to 5.

VALUE.—An ore of iron, yielding from thirty-six to fifty per cent. In powder, used as pigment and for polishing metals.

LOCALITIES.—Found usually in beds with granite or limestoné.

55.—RED SILVER ORE.

Occurs in crystals and masses; metallic lustre; brittle; powder cochineal-red; easily cut; at a high heat yields a silver globule; the powder heated with potash turns black; gravity 6.

VALUE.—An ore of silver yielding sixty per cent.

LOCALITIES.—Found at gold and silver mines.

56.—RENSSELAERITE.

Occurs in masses; wax-like; a trifle harder than marble; when fresh can be scratched by the nail; soapy feel; takes a polish; cleavable; gravity 2·8.

VALUE.—Used as a marble and worked into inkstands, etc.

LOCALITIES.—Found with *steatite*, *serpentine*, limestone, etc.

57.—ROCK CRYSTAL.

Occurs in crystals and masses; transparent; glassy lustre; colorless; tough; brittle; not acted upon by acids or heat; electric by friction; gravity 2·5.

VALUE.—Cut from ornaments, lenses, etc.

LOCALITIES.—Common in sandstone, limestone and iron ore.

58.—ROCK SALT.

Occurs in irregular beds or masses; brittle; saline taste; crackles in the fire.

LOCALITIES.—Found with *gypsum*, clay and sandstone.

59.—RUTILE.

Occurs in crystals generally; metallic lustre; powder pale brown; brittle; unchanged by heat or acids; if powdered and fused with potash, then dissolved in muriatic acid, the solution boiled with tinfoil assumes a beautiful violet color; gravity 4.

VALUE.—Used for colouring porcelain and artificial teeth.

LOCALITIES.—Found in granite and limestone rocks.

60.—SERPENTINE.

Occurs in masses; feeble, resinous lustre; color oily green; powder whitish; often yellowish; gray on the outside; can be cut easily; takes a fine polish; becomes reddish by heat; gravity 2·5—same as *Marble*.

VALUE.—Worked into mantels, jambs, table-tops and many other ornaments.

LOCALITIES.—Found as a rock in large masses.

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61.—Silicate of Copper.

Occurs in incrustations and masses; color bluish-green; not fibrous; surface smooth; easily cut; does not effervesce in acid; blackens by heat; gravity 2.

Value.—An ore of copper, yielding thirty per cent.

Localities.—Found with other copper ores.

62.—Silver.

Occurs in masses, or strings and threads penetrating rocks and native copper and galena; metallic lustre; tarnishes grayish black; can be cut in slices and hammered out; dissolved in muriatic acid, it turns black on exposure; gravity 10.

Localities.—Chiefly found with copper near trap-rocks, and in fine grained *galena* and dark brown *blende*. *Gold* contains from one to fifteen per cent.

63.—Silver Glance.

Occurs in small lumps, plates, and threads; color dark gray; cuts like lead; melts in a candle giving off sulphur fumes; gravity 7.

Value.—The most important ore of silver, containing eighty-seven per cent.

Localities.—May be found almost everywhere, except in the coal regions; associated with other ores, quartz, limestone, baryta, etc. Most abundant where mineral veins cross one another.

64.—Smaltine.

Occurs in crystals and masses; metallic lustre; color tin-white to steel-gray; powder dark gray; brittle; gives off garlic odor in a candle; melted with borax makes a deep blue glass; gravity 6·5 to 7.

Value.—An ore of cobalt and arsenic, containing eighteen to seventy per cent.

Localities.—Found in veins in granite regions with other ores.

65.—Smithsonite.

Occurs in masses, often rounded, covered with minute crystals, or honey-combed; color white, dirty yellow or stone color; glassy lustre; brittle; effervesces in nitric acid; barely scratches glass; barely translucent; gravity 4·4.

Value.—Yields fifty per cent. of zinc.

Localities.—Found generally in limestone with *galena blende*.

66.—Spathic Iron.

Occurs in crystals or plates somewhat curving; also (in coal regions) in nodules with concentric layers like an onion; brittle; color varies from white to yellowish-brown or dark-brown; strongly heated it blackens and will then attract the compass needle; the powder effervesces in nitric acid; melted with borax makes a green or yellow glass; gravity 3·8.

Value.—Yields thirty per cent. of iron, well adapted for steel.

Localities.—Found in granite and coal-formations, often with other ores.

67.—Specular Iron Ore.

Occurs crystallized and in large masses, high metallic lustre; color steel-gray or iron-black; brittle; opaque except when very thin; the powder when very fine and rubbed on white paper shows red; the powder dissolves slowly in muriatic acid; by a strong heat yields a black mass which attracts the needle; gravity 5.

Value.—Yields from fifty to seventy per cent. of iron.

Localities.—Found in granite regions.

68.—Spinel Ruby.

Occurs in pyramidal crystals; glassy lustre; powder white; scratches *rock-crystal*; by heat becomes black; gravity 3·5.

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VALUE.—A gem; clear specimens weighing over four carats, are valued at half the price of the *diamond*.

LOCALITIES.—Found in granular limestone and clay,

69.—STEATITE.

Occurs in masses, consisting of minute pearly scales or grains; can be marked by the nail; hardens by heat; soapy feel; gravity 2·5.

VALUE.—Used for fire-stones, tubes, in manufacture of porcelain, etc.

LOCALITIES.—Found in beds with limestone, serpentine and slate.

70.—STRONTIANITE.

Occurs in crystals and in fibrous or granular masses; glassy lustre; brittle; thin pieces melt before a blow-pipe tinging the flame red; effervesces with acids; gravity 3·6.

VALUE.—A source of nitrate of strontia used in fire-works.

LOCALITIES.—Found in limestone.

71.—SULPHUR.

Occurs in crystals, masses and crusts; brittle; can be easily cut; burns with a blue flame and sulphur odor; gravity 2.

LOCALITIES.—Found in limestone and gypsum, and around geysers and sulphur springs.

72.—TIN ORE.

Occurs in crystals, grains and masses; high lustre; powder gray or brownish; brittle; will strike fire with steel; unaltered by heat or acids; gravity 7,—being nearly as heavy as lead-ore.

VALUE.—The only ore of tin, containing seventy-nine per cent. No gold-mine ever paid such profits as the tin mines of Cornwall.

73.—TOPAZ.

Occurs in crystals; glassy lustre; brittle; scratches *rock-crystal*; not acted upon by ordinary heat or acids; gravity 3.5.

VALUE.—A gem; the most esteemed are the rose-red and white.

LOCALITIES.—Found in granite.

74.—TOURMALINE.

Occurs in crystals, usually in long, slender three-sided prisms which break easily, glassy lustre; brittle; becomes milk-white by heat; scratches *rock-crystal and garnet;* gravity 3.

VALUE.—Used for jewelry.

LOCALITIES.—Found in granite rocks.

75.—VARIEGATED COPPER ORE.

Occurs in crystals and masses; metallic lustre; quickly tarnishes; color between copper-red and light-brown; powder pale grayish-black; dissolves in nitric acid; at a high heat melts to a copper globule; heated on charcoal gives off fumes of sulphur; gravity 5.

VALUE.—An important ore of copper yielding sixty per cent.

LOCALITIES.—Found in granite, free-stone, etc., with other ores.

76.—WAD.

Occurs in masses; earthy and loose; can be broken by the fingers, and soils; no lustre; melted with borax makes a violet glass; feels very light.

VALUE.—Used in bleaching and for making smalt.

LOCALITIES.—Found in low places, generally in the vicinity of slate or iron ore beds.

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77.—Willemite.

Occurs in crystals and masses; feeble lustre; brittle; can hardly be cut with a knife; sometimes scratches glass; makes a jelly in muriatic acid; gravity 4.

Value.—Contains seventy per cent. of zinc.

Localities.—Found in limestone with *zincite*.

78.—Zincite.

Occurs in foliated masses or grains, powder orange-yellow; brittle; dissolves in acids without effervescence; gravity 5·5.

Value.—Yields seventy-five per cent. of zinc.

Localities.—Found in limestone with *Franklinite Garnet*, etc.

Prospecting for Diamonds, Gold, Silver, Copper, Lead and Iron.

The mineral riches of a country are frequently discovered by attentively observing the fragments brought down by the action of water from the hills into the valleys; and on tracing these to their several sources, the veins from which they were originally detached, are in many instances found. Water also acts in another way a very important part in the discovery of mineral veins, as by closely examining the faces of the different gullies and ravines, which intersect a country, a ready means is afforded of ascertaining whether its strata are traversed by metalliferous deposits; and, therefore, in exploring with a view to its mineral productions, no opportunity should be lost of observing the various sections thus naturally laid bare.

When fragments of an ore are found on a hill-side, it is very evident that the vein must lie higher up. If the vein is horizontal and the fragments are found on the top of the hill, there is no probability of finding much if any of the vein, for generally it has been washed away. Ore-veins, however, are almost always nearly vertical; so that boring is of little use, as it might pass by the richest vein, or, striking it lengthwise, give a too favorable result.

As heavy minerals do not drift far, metals are always found near their source.

Horizontal beds can be worked at the least cost.

Pockets and nodules, or any detached masses of minerals, are soon exhausted. Veins, lodes and beds are most valuable.

Boring a three-inch hole, which costs about $1 a foot, is a good method of testing a mineral vein or bed which lies more or less horizontally. A shaft may be sunk in sandstone for from $6 to $3 per cubic yard; in slate and gravel, at from $2 to $1.

The existence of mineral springs, and the rapid melting of the snow in any locality, are no indications of ores.

Searching for Diamonds.—Few things are so unpromising and unattractive as gems in their native state. Hence their slow discovery. There is little doubt that diamonds exist in many places as yet unknown, or where their presence is unsuspected. It is very difficult for the unpractised eye to distinguish them from crystals of quartz or topaz. The color constitutes the main difficulty in detecting their presence. They are of various shades of yellowish brown, green blue and rose-red, and thus closely resemble the common gravel by which they are surrounded. Often they are not unlike a lump of gum arabic, neither brilliant nor transparent. The finest, however, are colorless, and appear like rock-crystals.

In Brazil, where great numbers of diamonds, chiefly of small size, have been discovered, the method of searching for them is to wash the sand of certain rivers in a manner precisely similar to that employed in the gold fields, namely, by prospecting pans. A shovelful of earth is thrown into the

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pan, which is then immersed in water, and gently moved about. As the washing goes on, the pebbles, dirt and sand are removed, and the pan then contains about a pint of thin mud. Great caution is now observed, and ultimately there remains only a small quantity of sand. The diamonds and particles of gold, if present, sink to the bottom, being heavier, and are selected and removed by the practised fingers of the operator. But how shall the gems be detected by one who has had no experience, and who in a jeweler's shop could not separate them from quartz or French paste? The difficulty can only be overcome by testing such stones as may be suspected to be precious. Let these be tried by the very sure operation of attempting to cut with their sharp corners glass, crystal or quartz. When too minute to be held between the finger and thumb, the specimens may be pressed into the end of a stick of hard wood and run along the surface of window glass. A diamond will make its mark, and cause, too, a ready fracture in the line over which it has travelled. It will also easily scratch rock-crystal, as no other crystal will.

But a more certain and peculiar characteristic of the diamond lies in the form of its crystals. The ruby and topaz will scratch quartz, but no mineral which will scratch quartz has the *curved edges* of the diamond. In small crystals this peculiarity can be seen only by means of a magnifying glass; but it is invariably present. Interrupted, convex or rounded angles, are sure indications of genuineness. Quartz crystal is surrounded by six faces; the diamond by four. The diamond breaks with difficulty; and hence a test sometimes used is to place the specimen between two hard bodies, as a couple of coins, and force them together with the hands. Such a pressure will crush a particle of quartz, but the diamond will only indent the metal.

The value of the diamond is estimated by the carat, which is equal to about four grains, and the value increases rapidly with its weight. If a small, rough diamond weigh four grains, its value is about $10; if eight grains, $40; if sixteen grains, $640. A cut diamond of one carat is worth from $50 to $100.

The imperfections of the diamond, and, in fact, of all cut gems, are made visible by putting them into oil of cassia, when the slightest flaw will be seen.

A diamond weighing ten carats is "princely"; but not one in ten thousand weighs so much.

If a rough diamond resemble a drop of clear spring water, in the middle of which you perceive a strong light; or if it has a rough coat, so that you can hardly see through it, but white, and as if made rough by art yet, clear of flows or veins; or, if the coat be smooth and bright, with a tincture of green in it,—it is a good stone. If it has a milky cast, or a yellowish-green coat, beware of it. Rough diamonds with a greenish crust are the most limpid when cut.

Diamonds are found in loose pebbly earth, along with gold, a little way below the surface, towards the lower outlet of broad valleys, rather than upon the ridges of the adjoining hills.

Searching for Gold.—The paying localities of gold deposits are the lopes of the Rocky and Alleghany Mountains. Gold need not be looked for in the anthracite and bituminous coal-fields nor in limestone rock. It is seldom found in the beds of rivers. The thing itself is the surest indication of its existence. If soil or sand is "washed" as described in Chapter V., and the particles of gold are not heavy enough to remain at the bottom, but float away, the bed will not pay.

Along streams rather high up among the mountains, and in the gravelly drift covering the slopes of the valley below, are the best prospects. Where, the stream meets an obstacle in its path or makes a bend or has deep holes there we may look for "pockets" of gold. Black or red sands are usually richest. Gold-bearing rock is a slate or granite abounding in rusty looking quartz veins, the latter containing iron pyrites or cavities. Almost all iron pyrites and silver ores may be worked for gold. When the quartz veins are

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thin and numerous rather than massive, and lie near the surface, they are considered most profitable. Few veins can be worked with profit very far down. As traces of gold may be found almost everywhere, no one should indulge in speculation before calculating the precentage and the cost of extraction. Gold-hunting, after all, is a lottery with more blanks than prizes.

The substances most frequently mistaken for gold are *iron pyrites*, *copper pyrites* and *mica*. The precious metal is easily distinguished from these by its malleability (flattening under the hammer) and its great weight, sinking rapidly in water.

SEARCHING FOR SILVER.—This metal is usually found with lead ore and native copper. Slates and sandstones intersected by igneous rocks as trap and porphyry, are good localities. Pure silver is often found in or near iron ores and the dark brown zinc blende. The Colorado silver lodes are porous at the surface and colored more or less red or green. Any rock suspected of containing silver should be powdered and dissolved in nitric acid. Pour off the liquid and add to it a solution of salt. If a white powder falls to the bottom which upon exposure turns black, there is silver in it. Silver mines increase in value as in depth, whereas gold diminishes as we descend.

SEARCHING FOR COPPER.—The copper ores, after exposure, or after being dipped in vinegar, are almost invariably green on the surface. They are most abundant near trap dykes. The pyrites is generally found in lead mines, and in granite and clay-slate. Copper very rarely occurs in the new formations, as along the Atlantic and Gulf borders, and in the Mississippi Valley south of Cairo.

SEARCHING FOR LEAD.—Lead is seldom discovered in the surface soil. It is also in vain to look for it in the coal region and along the coast. It must be sought in steep hills, in limestone and slate rocks. A surface cut by frequent ravines or covered by vegetation in lines, indicates mineral crevices. The galena from the slate is said to contain more silver than that from the limestone. The purest specimens of galena are poorest in silver; the small veins are richest in the more precious metal. A lead vein is thickest in limestone, thinner in sandstone and thinnest in slate.

SEARCHING FOR IRON.—Any heavy mineral of a black, brown, red or yellow color may be suspected to be iron. To prove it, dissolve some in oil of vitriol and pour in an infusion of nut-gall or oak-bark; if it turns black, iron is present. If a ton of rich magnetic ore cost more than $4 at the furnace good hematite more than $3, and poor ores more than $1·50 or $2, they are, too expensive to pay unless iron is unusually high. Deep mining for iron is not profitable. Generally speaking, a bed of good iron ore, a foot thick, will repay the cost of stripping it of soil, etc., twelve feet thick. Red and yellow earths, called ochres, contain iron. Magnetic ore is easily found by a compass.

ASSAY OF ORES.

One of the first questions asked after the discovery of a mettallic ore, is—"will it pay?" We propose to state in plain words a method of determining the character and value of the principal ores, so that any intelligent man, however unscientific, may answer his own question. The chemical analysis or exact assaying of ores is too complicated, and must be left to professional assayers.

"Will it pay?" is an important query; for many ores of even precious metals, are not "paying." Whether an ore is profitable depends not so much upon the relative value of the metal as upon the ease of separating it from the rock or "gangue" as it is called. Thus the minimum percentage of metal, below which the working of the ore ceases to be profitable is—

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Of Iron	25	per cent.
Zinc	20	"
Lead	20	"
Antimony	20	"
Copper	02	"
Tin	01½	"
Quicksilver	01	"
Silver	$\frac{1}{2000}$	
Platinum	$\frac{1}{10000}$	
Gold	$\frac{1}{100000}$	

That is, an ore of iron which contains less than 25 per cent. of metal will not pay for working; for the reduction of iron in comparison with copper ore is very difficult. Gold is very easily extracted, and hence some quartz rocks which do not apparently contain a particle of gold, pay well a bushel of rock often yielding half an ounce.

Iron occurs in large masses or beds; but the other metals are scattered in fragments through sand or soil, or exist in veins running through rocks.

WASHING FOR GOLD AND PLATINUM.—This operation, called "panning," is the oldest and simplest method of extracting the precious metals. At the present time, it furnishes to Russia nearly all the gold produced in that empire. It is based on the principle that substances of different weights may be separated by means of water,—the heaviest going to the bottom first. To examine the bank or bed of a river, suspected to contain gold, fill a milkpan with the sands and carry it to a tub or pool of quiet water. Dip it under, stirring the mass with one hand or a stick. Then pour off the muddy water, fill with fresh water stirring again, and again pour off the light sand, clay, etc. Scales of gold will sink fast; mica flakes will take their time. Repeat this process till all the fine particles are washed off; then allow just enough water to enter the pan as will cover the sand. By shaking the pan and gradually lowering the side by which it is held, the sand will flow off, leaving in the corner a heap of coarse sand. Put in a small quantity of water and turn the pan around so as to create a gentle current, when the precious metal, if there be any, can be easily detected,—the gold by its bright lustre, the platinum by its lead color, and both by their malleability. Particles of gold are of uniform color and are either flat or rounded; while other yellow grains are angular. Holding the pan in the sunshine, secure any glittering glassy crystals, and test them for diamonds or rock-crystals. A magnet will remove any particles of magnetic iron-ore.

ASSAY OF GOLD ORE.—Gold may be found in quartz rock, in iron and copper pyrites, and in silver ores.

To ascertain if any gold is present in quartz, reduce the rock to powder and sift it. A certain quantity, say half a peck, is then washed as above described, till a manageable quantity of sand is left. If there is any show of gold, dry the mass and put it in a bowl or glass dish, and add an ounce of quicksilver, stirring the mixture well with a wooden rod. The quicksilver, which will unite with every particle of gold which may be there, is then poured off into a soft leather (chamois) bag. This is squeezed to remove superfluous quicksilver, and a pasty amalgam is left, which is put into an iron vessel and heated red hot. The yellow powder remaining is mixed with saltpetre and melted, when a button of pure gold will be found in the crucible. Quartz ores should yield $6 to the ton in order to pay.

To test pyrites for gold, reduce a given quantity to powder and wash as before; then roast the residue at a red heat. Upon cooling, add quicksilver and treat as just described. Pyrites should yield $1 of gold to the bushel of ore to be profitable.

Native silver often contains gold. To separate them, carefully flatten the

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the alloy with a smooth hammer on an anvil, and then boil it in strong nitric acid in a glass flask for about ten minutes. Carefully pour off the acid into a vial, and wash the powder in the flask (which is fine gold) with water and dry. To the liquid in the vial add a solution of common salt. The white powder which falls should be removed, washed with water, and fused with powdered chalk or iron filings; a button of pure silver is the result.

Any substance supposed to be or to contain gold may be tested by dissolving it powdered in aqua regia aud then pouring in a solution of copperas; if there is gold, the reddish-brown precipitate, by rubbing, assumes a bright metallic lustre.

To tell whether a globule of silver has any gold it in, put it on a white porcelain dish and moisten it with a drop of nitric acid; if it is pure silver, it will dissolve and retain its white color; if mixed with gold, it will soon turn gray or black.

To test the purity of gold, rub some of it off on a hard black flint slate, and apply to the mark a drop of aqua fortis. If the gold is pure, the yellow streak remains unchanged, but if alloyed it partly disappears; if it is only an imitation of gold, it vanishes altogether.

A ready method of finding the amount of gold in a quartz rock with considerable accuracy, is by taking the specific gravity of the rock (well cleaned) as given on page 13. If the gravity is not over 2·7, it contains little or no gold. If it is 3, it very likely is gold-bearing, although pyrites may be present. But if it is over 5, it is undoubtedly auriferous, and if 12, it is very rich in gold.

It is generally considered that the sand of any river is worth working for the gold it contains, provided it will yield twenty-four grains to the hundred weight.

Assay of Silver Ore.—Pure silver is easily recognised. But lead and copper ores often contain a large percentage of the precious metal.

To detect silver in lead ore, dissolve the powdered ore in strong nitric acid; pour off the liquid and insert a piece of pure copper. If silver is present, it will go to the bottom. Or add to the liquid a solution of common salt, and it will instantly become cloudy or white. If lead ore yields three ounces of silver to a ton, it may be worked for the silver as well as the lead. In Colorado, the average value of silver-bearing galena is $100 per ton.

To test the copper ores for silver, dissolve them in nitric acid; then add a few drops of muriatic acid, and if silver is present, a white curdy precipitate will fall to the bottom. Native copper, when polished, often shows white spots of silver.

To estimate the proportion of silver in lead ore, reduce a known quantity of the clear ore to powder, mix with a little dry soda and a few nails and heat in a round bottomed iron pot or crucible. The lead which is obtained should then be put in a cup having ashes at the bottom, and strongly heated in an open furnace. A globule of silver will be left, if any is present, and being weighed, the percentage can be found.

Rich silver ores may be reduced by mixing them with ten parts of common salt, and exposing the mass for hours in an open furnace, stirring it frequently. When cold reduce to powder and mix with an equal quantity of quicksilver and enough water to make a paste, and agitate the mixture for two days, when the amalgam will fall to the bottom. The amalgam is then squeezed in a leather bag and washed.

Silver glance will yield its metal by heating it before a blow-pipe.

Assay of Copper Ore.—When the ore is native copper and rock, as at Lake Superior, it should be pounded and the earthy matter washed away. Then mix with a little potash or soda and bring to a high heat in a crucible.

Other copper ores may he tested by dissolving them powdered in dilute aqua regia. The presence of silver will be shown by a white powder on the bottom. Then add considerable ammonia, If there is any copper a blue liquor

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will be produced. Strain this through tissue paper, and evaporate to dryness. Dissolve the residue in muriatic acid, and by putting in a piece of iron or zinc, the copper will fall down. Or add to this solution pure potash; dry and weigh the powder thrown down; every 5 parts of it contains 4 parts of copper.

Gray copper and red copper ores may be assayed by heating with charcoal (both powdered) in a furnace. Malachite and azurite should be smelted with borax; copper pyrites and silicate of copper with soda or powdered marble.

A ton of copper ore which contains ten per cent. of metal, pays $25 at the furnace. The ore of copper when roasted, turns black; and when thrown into nitric acid makes a sky-blue solution. A clean knife-blade put into this solution will be coated with copper.

Assay of Iron Ore.—Take a known quantity of the ore in fine powder and mix thoroughly with dry borax (or with one part of fluor spar, one of charcoal and four of salt), and expose it for an hour in a covered crucible lined with charcoal to a white heat in a wind-furnace for an hour. A button of iron will be found at the bottom, which determines the percentage.

Assay of Zinc Ore.—If the weighed ore is roasted with powdered charcoal, white flowers of zinc will be formed on a piece of cold iron held over it. After thorough roasting, the residue should be weighed; the loss is the oxide of zinc, and every 100 parts of this contain 81 of metal.

All the ores of zinc will dissolve in either nitric or hot sulphuric acid.

Assay of Tin Ore.—Tin-stone will yield up its metal if mixed with charcoal, borax and soda, and heated on the hearth of a furnace or before a blow-pipe.

The presence of tin may be tested by dissolving the metal thus roasted out, in aqua regia and adding a decoction of Brazil-wood: if the metal was tin, the liquid will be colored a beautiful crimson.

Assay of Lead Ore.—Both galena and cerussite are rich ores, and when abundant pay well. They are easily reduced by heat, the former being usually mixed with charcoal and iron filings. If a western backwoodsman wants shot or bullets, he kindles a fire in a hollow tree or an old stump, puts some galena on the charred wood, and melts it down. After cooling, he finds the metal at the bottom. The smelting of a ton of lead costs about $6. The average price per ton of galena is $30. When galena is dissolved in warm nitric acid, a clean plate of zinc placed in it will be coated with brilliant blades of lead; if the galena contains silver, a plate of copper will be served in the same way. A solution of chromate of potash poured into a solution of lead ore in nitric acid will throw down a yellow powder.

To Test the Purity of Graphite.—Its value depends upon the amount of its carbon. Pulverize and then dry at a heat of about 350 degrees, twenty grains of it; then place it in a tube of hard glass four or five inches long, half an inch wide and closed at one end. Add twenty times as much well dried oxide of lead and well mix. Weigh the tube and contents, and afterwards heat before a blow-pipe till the contents are completely fused and no longer evolved gases. Ten minutes will suffice for this. Allow the tube to cool and weigh it. The loss in weight is carbonic acid. For every twenty-eight parts of loss there must have been twelve of carbon.

Artificial Jewelry—How Made and how Detected.

"Bristol Stones," "Irish Diamonds," "Cape May Diamonds," and "California Diamonds" are skilfully-cut quartz crystals. They are easily detected by the file and by their lightness.

"Paris Brilliants" are more dangerous counterfeits, and are very often sold for genuine. The great establishment of Boarguiguon, in Paris, is the most famous manufactory of artificial gems in the world, employing about one hundred hands.

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The gems are such perfect imitations that they can be distinguished from real stones only by the closest scrutiny of those experienced in such matters. They fail chiefly in hardness; in brilliancy and gravity they nearly or quite equal the genuine.

Nature has made the most precious stones with the most common materials. The diamond is purified charcoal; while the matter of clay and white pebbles is the base of all other gems.

The chemist has imitated nature in the production of colored gems. The base of these imitations, called "pastes," is "*strass*"—a white grass compound of 300 parts of pure sand, 96 of potash, 27 of borax, 514 of white lead, and one of arsenic. The mixture is put into a crucible and kept at a high heat for 24 hours. This is the philosopher's stone which competes with Golconda. The uncolored glass is used in making mock diamonds and white topaz. Another paste which has very great brilliancy, and, unfortunately, the same gravity as the diamond, is made by melting 100 parts of pure sand, 150 of red lead, 30 of calcined potash, 10 of calcined borax and one of arsenic, keeping the mixture melted for two or three days and then cooling very slowly. Each ingredient is separately reduced to a fine powder.

FALSE RUBY is made by fusing together of strass one ounce and six drams, glass of antimony 37 grains, and purple of cassius one grain; then add eight parts more of strass and fuse for thirty hours; cool and remelt pieces in a blow-pipe. Or, melt five ounces of strass and one dram of manganese.

FALSE TOPAZ can be made from 1,008 grains of strass, 43 grains of glass of antimony and one grain of purple of cassius.

FALSE SAPPHIRE.—Add to eight ounces of strass 52 grains of pure oxide of cobalt.

FALSE EMERALD.—To one pound of strass add one dram of verdigris and fifteen grains of crocus martis. Or, take 2,304 grains of strass, 21 grains of green oxide of copper, and one grain of oxide of chrome. Or, take an ounce and a half of rock-crystal, six drams of dry soda, two drams of dry borax, two drams of red lead, one dram of nitre, twenty grains of red oxide of iron, and ten grains of green carbonate of copper.

FALSE CARNELIAN.—Strass two pounds, glass of antimony one pound, rouge two ounces, manganese one dram.

FALSE AMETHYSTS AND OPALS are manufactured; but the fine opal defies imitation, and the amethyst is too common in nature to allow much margin for the "pastes."

In distinguishing true and false gems, no one character should be depended upon. All genuine stones will bear rough handling; if the merchant says "hands off," refuse to purchase. Any gem worth buying is worth testing.

First: try the *hardness*. The file will make no impression on the diamond and ruby, and will with difficulty scratch the other gems; while the "pastes" are easily marred. All the precious stones scratch window glass, although opal will not attack common bottle glass. All imitations easily yield to sand. The sapphire is the hardest of colored gems, and opal is the softest. The emerald will hardly scratch rock-crystal; its counterfeit not at all. Topaz will scratch ordinary ruby, but will not touch sapphire.

Secondly: as to *weight*. This is the most accurate method, but the stone must be taken from its setting. The mode of taking the gravity has already been given (page 231), and the amount of each is stated in Chapter II. Garnet is the heaviest of gems; weighed in water it loses only one-fourth of its weight; *i. e.*, if a red garnet be suspended by a fine thread from a delicate balance and immersed in a glass of water under it, one-quarter of its ordinary weight in air must be added to the pan from which it is suspended to restore the equilibrium. In like manner, ruby and sapphire lose a little more. The diamond and white topaz lose two-sevenths of their weight. Rock-crystal, amethyst, carnelian and agate lose five-thirteenths; and opal about one-half, being the lightest of gems. The emerald loses more than one-third.

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As "paste" *can* be made so as to have the same specific gravity as the genuine article, this test alone cannot be relied upon; but very few of the imitations are so carefully made. The test is very convenient in distinguishing gems of like color from each other, as oriental ruby, spinel ruby and red tourmaline, and green tourmaline and emerald.

Thirdly: characteristics depending on *light* and *electricity*. It is not easy to look through a diamond of the first water, while imitations readily permit objects to be seen through them. A very delicate and perfect test of a diamond, distinguishing it from all the colorless gems, as white topaz, white sapphire and white zircon, but not from "pastes," is to look through it at a pin-hole in a card. This requires some dexterity, and the gem should be fixed to a steady object by a bit of wax at a proper distance. A true diamond will show but one hole, all the others will show two. As white topaz, when large, is a magnificent stone, it is often palmed off for a diamond of great value; but this test is invariably certain.

A true diamond retains its brilliancy under water.

When a colored stone is placed in the path of the solar spectrum (the row of seven colors into which sunlight is separated by a prism), its color will vary with the portion of the spectrum which falls upon it; and two stones of the same color, but of a different nature, will exhibit different effects. Thus, a paste placed beside a fine colored gem, betrays its worthlessness. A simpler method of testing stones is to look at them through a bit of glass, colored red, yellow, blue or green. Every stone will exhibit, under this test, properties peculiar to itself, and by which its nature may be recognized. This is also a severe test for the purity of tint; for if pure and unmixed, the stone will appear completely black in every other light but its own color. Milky and turbid stones cannot bear this test.

A first-class ruby has the color of the blood as it spirts from an artery. The deeper the hue of the emerald the more it is valued; it loses none of its brilliancy by artificial light. The pale rose topaz, the kind most esteemed, is artificially colored by heating it.

If topaz or tourmaline be gently heated, it becomes electric and will attract a thread or suspended pith-ball. No imitation will do this. All real gems when rubbed will attract the pith-ball, and retain the power a long time; the pastes also become electric, but soon lose their attraction. Rub a glass tube with a piece of flannel and bring it near a suspended pith-ball; the latter will be strongly attracted and then repelled. Immediately rub a genuine diamond and bring it near the ball, and it will be attracted. A paste diamond thus rubbed would repel it.

Finally: the breath remains much longer on the pastes than on real gems. The former also betray under a magnifying glass small air bubbles. Diamonds and other first-class stones are always cold to the touch.

False Pearls.—These are glass beads coated with a mixture of three ounces of scales of the blay or bleak fish, half an ounce of fine glue, one ounce of white wax and one ounce of pulverized alabaster. Powdered opal is sometimes used; also the powdered pearl of the oyster and other shells soaked in vinegar, and made up with gum tragacanth. Artificial pearls are usually brittle, and do not weigh more than two-thirds as much as the genuine.

False Corals.—These are made of resin and vermillion; or of marble powder made into a paste with varnish or soluble glass and a little isinglass, colored by Chinese vermilion and then moulded. They are used for setting in cheap jewelry. The knife shows it to be too soft to be genuine.

Artificial Gold.—The following oroid or imitation gold is sometimes sold for the genuine article which it closely resembles. Pure copper 100 parts by weight, is melted in a crucible, and then 6 parts of magnesia, 3·6 of sal-ammoniac, 1·8 of quicklime and 9· of tartar are added separately and gradually in the form of powder. The whole is then stirred for about half an hour, and 17 parts of zinc or tin in small grains are thrown in and thoroughly mixed. The crucible is now covered and the mixture kept melted for half an hour longer, when it is skimmed and poured out.

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Any imitation of gold may be detected by its weight, which is not one-half of what it should be, and by its dissolving in nitric acid while pure gold is untouched.

PRECIOUS STONES ARRANGED ACCORDING TO COLOR AND IN ORDER OF HARDNESS.

Limpid.
Diamond,
Sapphire,
Topaz,
Rock Crystal.

Blue.
Sapphire,
Topaz,
Spinel,
Aquamarine,
Indicolite,
Turquoise,
Kyanite.

Green.
Oriental Emerald,
Chrysoberyl,
Emerald,
Chrysoprase,
Chrysolite,
Amazon Stone,
Malachite.

Yellow.
Diamond,
Topaz,
Fire-Opal.

Red.
Sapphire-Ruby,
Spinel-Ruby,
Brazilian-Topaz,
Hyacinth,
Carnelian,
Rubellite,
Garnet.

Violet.
Oriental Amethyst,
Amethyst.

Black and Brown.
Diamond,
Tourmaline,
Hyacinth,
Garnet.

PRECIOUS STONES AND GEMS.

By Edwin W. Streeter.

THE ORIENTAL RUBY.

The Oriental Ruby is a Corundum, and is sometimes found loose in sand or débris in company with other Precious Stones, but more often it is embedded in Granite, Basalt, Gneiss, Talc, Syenite, and Hornblende. It consists of alumina with a little coloring matter. The specific gravity of the Oriental Ruby is 4·6 to 4·8, and its hardness 9. It will cut Sapphire, Emerald, Topaz, Rock Crystal, and all other stones, save the Diamond. It possesses double refraction, though in a small degree, and the electric condition obtained by friction remains for hours. Its color is Carmine, Cochineal, or Pigeon-blood, and Rose-red often with a play of Violet. It is frequently asserted that the white spots often detected on the rough stone, may be removed by careful appliance of heat; but this is not true, and it is certainly a dangerous experiment, for if heat be recklessly applied, it will split the stone into pieces. Kluge says "that before the blow-pipe it shows a remarkable change of colors, which is, the more striking in the small pieces. If small crystals are made red hot and allowed to cool, they become colorless, then after a time green, and lastly they regain their beautiful red color." I cannot vouch for this from my own experience, but if true, this experiment would be most valuable as the means of ascertaining the genuineness of the Oriental Ruby: crystals of Red Spinel never become green in the process of heating and cooling.

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The so-called Brazilian Ruby is a pink Topaz, and differs entirely in its characters from Rubies. Its specfic gravity is 3·4 to 3·6. Hardness 8. It cuts Rock Crystal, but less easily than the others; possesses double refraction, and retains electricity for twenty-four hours. Broken pieces when heated show a phosphorescent blue light. The original color of most of these Rubies is yellow, and it is by means of heat they receive the beautiful bright red or dark cochineal; they are found mostly in the débris of Mica-schist, in brown iron stone, or in quartz veins.

There are some very famous and remarkable Rubies on record. For example, there was an Oriental Ruby of the size of a pigeon's egg in the crown of the Empress Catharine of Russia, which is said to have been presented to her by Gustavus III. of Sweden, when on a visit to St. Petersburg, 1777. One in Paris, seen by Faretière, weighed 406½ carats, and Chardin speaks with admiration of a Ruby cut "*en cabochon*," of great beauty, and of the size and form of half an egg, having the name of "*Thelk Lephy*" engraved on the point.

There are two very large Rubies in the possession of the King of Awakan, in India.

The King of Ada has a perfect Ruby of the size of a small hen's egg, which he wears as an eardrop.

The slippers of Chinese and Indian women are ornamented with Rubies cut *en cabochon*, that is with convex, non-faceted tops; vases, armour, scabbards and harness, are also graced by the same stone in India and China. These stones, however, are of little value. Bags of them are, indeed, laid beneath the foundations of buildings, the idea prevailing that good fortune was thus secured to the structure.

It is reported that the King of Burmah has a Ruby of the size of a pigeon's egg and of extraordinary quality, but no European has seen it.

The two most important Rubies ever known in Europe, were brought into this country during the year 1875. One was a dark-colored stone, cushion-shape, weighing 37 carats, the other a blunt, drop-shape, of $47\frac{1}{16}$ carats.

It was deemed advisable to have these stones re-cut; and the work was entrusted to Mr. James N. Foster, of London, who re-cut the stone of 37 carats to $32\frac{5}{16}$, and the one of 47 carats to $39\frac{9}{16}$. They were much improved by the re-cutting, and competent judges pronounced them the finest stones of their size yet seen, their color being truly magnificent. I have reason to believe that the smaller stone of the two was sold abroad for over £10,000; the larger one likewise found a purchaser on the continent. The fact of two such fine gems appearing contemporaneously is unparalleled in the history of Precious Stones in Europe. It is questionable, however, if the London market would ever have seen these truly royal gems, but for the poverty of the Burmese Government, which is said to have been the cause of their disposal. In Burmah, the sale of these two Rubies caused intense excitement: a military guard being considered necessary to escort the persons conveying the package to the vessel. No regalia in Europe contains two such fine and important Rubies.

The most beautiful Rubies come from the kingdom of Burmah, about five days' journey east-south-east of Ava. The inhabitants believe that they ripen in the earth; that they are at first colorless and crude, and gradually as they ripen become yellow, green, blue, and last of all, *red*, this being considered the highest point of beauty and ripeness. There is a law in force in Burmah, which deprives the market of the most beautiful Rubies. Whoever finds a Ruby of a certain weight (100 Ticals), is bound under pain of losing his life, to deliver it up to the Financial Department of the Government. In order to avoid this loss of life and property, the finder breaks it up into small pieces, thereby causing infinitely greater loss to the Government than he gains. Surely this is a traveller's tale. It was thought that when Pegu, the

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"Fatherland of Rubies," was annexed to England in 1852, Europe would be the richer in these beautiful stones, but it has not proved so. It appears that certain dangers exist, or are said to exist, in the lands where Rubies are found, such as wild beasts and reptiles. It is possible that these may be exaggerated by the Ruby merchants in order to hinder competition. The King of Burmah is known to be excessively fond of these stones. He jealously prohibits the export of them, so that, save through the agency of private individuals or by stealth, scarcely any Rubies pass out of his country.

Very beautiful Rubies have been found in a part of Tartary called Badakshan for many years. They are found also on the slopes of the Oxus, near to Shushan and Charan. The inhabitants believe that Rubies always occur in "pairs." When one of the seekers has fortunately discovered one, he will frequently hide it till its mate is found.

The Oriental Ruby is indisputably one of the most valuable of Precious Stones. Theophrastus speaks of it as incombustible, and as having the appearance of a burning coal when held up to the sun. He is said to have given forty gold pieces for a very small one. The price paid for this stone by the Ancients was very high. According to Benvenuto Cellini, in his time a perfect Ruby of a carat weight cost 800 Ecus d'Or, whilst a Diamond of like weight cost only 100.

In this our day fine Rubies under half-a-carat—

If English cut, cost from ... ... £4 to £10
If Indian cut ,, ... £1 ,, £4

Those over a carat in weight are, according to the quality, from £20 to £100 per carat; but no definite price can be given as a guide to the purchaser. No stone increases so much in value, in relation to size,—all excellencies being the same,—as the Oriental Ruby. One of less than twenty-four carats weight, the property of an Indian prince, has been bought for 156 lbs. weight of gold. It ranks first for price and beauty amongst all colored stones. When a perfect Ruby of five carats is brought into the market, a sum will be offered for it ten times the price given for a Diamond of the same weight; and if a Ruby reaches the weight of ten carats it is almost invaluable.

Rubies with flaws, or with specks of a milky appearance on the table or beneath it, and Rubies of too deep or too light a color are now much depreciated in value. In former years, when the inferior stones could be sold in the foreign markets, they were worth at least fifty per cent. more than they are at the present time.

There are, it is true, many large Rubies to be met with in the market, and this statement may seem to contradict the above assertion, but these are by no means of the same value as the Burmese Rubies. They come from Siam, and have a distinctly dark brown tint, marring the true "pigeon's blood" hue. This variety does not realise above half the price obtained for Rubies of the same size of the true color.

THE SAPPHIRE.

No Precious Stone is more interesting to the general reader than this. In old Arabic it was termed "Sappeer," to scratch; and in Syriac and Hebrew, by verbs cognate and of similar signification. The Chaldean characters of the alphabet and ancient books were called by the same "word" probably because of the great hardness of the Sapphire, and the ease with which stones and rocks could be scratched or engraven by it. This gem is known to almost all nations by the one name Sapphire. It is a Corundum, and is found most frequently in secondary deposits, loose in sand, or in débris with other Precious Stones. Occasionally, however, it is found embedded in primary deposits, in Granite, Syenite, Basalt, Geneis, Talc, and Hornblende, strata of speculiar iron, and magnetic ironstone.

The type of its crystallization is the six-sided prism, and the hexagonal

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pyramid. Its specific gravity is 3·9 to 4·2. In color, it is a beautiful blue, like to that of the blossom of the little weed called the "corn-flower;" and the more velvety its appearance, the greater the value of the stone. The Oriental Sapphire retains its exquisite color by gas-light, while that of the less valuable becomes black, or like to an Amethyst in color. Pliny knew this gem well, and speaking of its color compares it to the same flower as we do. It can now be imitated, but the Ancients had no idea of the possibility of such a thing; and yet the dark-blue glass of the antique vase, with its dazzling white bas relief, in the British Museum, is world-renowned for its color and exquisite beauty. No doubt the color of the Sapphire depends upon a small *ingredient* of chrome. Strange to say, up to quite modern times it was regarded as a medicine, and very extraordinary powers were attributed to it. It was dedicated by the Greeks to Apollo, because, when consulting his oracle, they thought that the possession of this gem, from its heavenly nature, would secure them an early and favourable answer.

In consequence of its hardness, its beautiful color, and its bright, vivid lustre, it is one of the most prized as well as one of the most fashionable of gems. It will always be an article of luxury from its comparatively high price.

The Ancients knew and made use of the Sapphire, but rarely for outward adornment, possibly because of the difficulty of manipulating so hard a stone. For personal ornaments it receives the form of the Brilliant, which shows to best advantage the lustre of the stone.

Sapphires were originally obtained from Arabia and Persia; but now the finest stones are imported from the kingdom of Burmah. The same laws are in force, regarding the finding of Sapphires, as noticed in the chapter on Rubies. In Ceylon, Sapphires are not rare; they are found in the débris of the mountains. In North America, Sapphires are found in rhomboid crystals, or six-sided prisms, of a beautiful blue, in combination with Hornblende, Glimmer, Felspar, Iron-pyrites, Talc, and in Granular Limestone; this is specially the case in Newton, New Jersey. In South Australia (Ballarat, in Victoria), blue and white Sapphires are found so worn away that no trace of crystallization is left. Sapphires are also obtained from the clefts of the hanging rocks on the pearl rivers in New South Wales. Sapphires are found in many parts of Europe; on the tops of the Iser Mountains in Bohemia. The river Iser having a very rapid current carries with it, in the soil, Sapphires and other Precious Stones, and often deposits them on its shores, far away from their original home. In the Sieben-Gebirge, small Sapphires are found with gold in the sand. In Saxony they are embedded in alluvium; specially is it so in Saxon Switzerland.

Amongst the celebrated Sapphires is that which was seen by the English ambassador, who was sent to Ava. It was said to be 951 carats in weight, of a beautiful blue, and without a flaw. In the collection of minerals in the Jardin des Plantes, in Paris, is one of the most beautiful Blue Sapphires, weighing $132\frac{1}{16}$ carats, without spot or fault. This stone was originally found in Bengal by a poor man; it subsequently came into the possesion of the House of Rospoli, in Rome, who, in their turn, left it to a German prince, who sold it to the French jewel merchant, Perret, for 170,000 francs, a sum much less than its real value.

Notwithstanding the extreme hardness of the Sapphire, there are some beautiful engraved specimens still in existence. In the cabinet of Strozzi, in Rome, is a Sapphire, a masterpiece of art, with the profile of Hercules engraven on it by Ceneïus. A very remarkable and famous Sapphire, belonging to the Marchese Rinuccini, weighing fifty-three carats, has a representation of a hunting scene engraven on it, with the inscription, Constantious Aug. Among a number of old family jewels recently in my possession, I found a Sapphire beautifully engraved with the crest and arms of Cardinal Wolsey.

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The value of these stones is very much determined by special circumstances, and like the Diamond, its color, purity, and size are taken into consideration when fixing the sum to be paid. Fine Sapphires under the carat in weight, if English cut, vary from £4 to £12; if Foreign cut, £2 to £5; those of a carat weight, £12 to £25. Sapphires, do not, like the Ruby, rise in price as they increase in size.

The Oriental Sapphire is the most highly valued; and a perfect stone, weighing about three carats, is even more costly than a Diamond of like weight and similar quality. Those imperfections which appear at times in the Sapphire, and which lessen its value, are clouds, milky half-opaque spots, white glassy stripes, rents, knots, a congregating of colors at one spot and silky-looking flakes on the table of the stone. Not only are other stones of like order sold for the Sapphire, but even glass (technically called flux).

Varieties of "Doublet," (that is counterfeit stones, composed of two pieces of crystal, with a color between them, so that they have the same appearance as if the whole substance of the crystal were colored), are passed not infrequently for Sapphires. They may be distinguished from the genuine stone partly by their color, but more especially by a careful examination of the girdle, when, should the Sapphire have been joined to an inferior stone, the attempted deception will be detected.

CORAL.

Coral is the produce of gelatinous creatures which come under the class of Polypi: there are many varieties, but we have only to do with Precious Coral—"Isis Nobilis." This Polypus production is like a tree with leafless branches, the stem of which, in rare cases, is as thick as a man's body, but generally about a foot high, and an inch thick.

The calcareous axis of the "Isis Nobilis" is distinguished by its size, hardness, and capability of polish, as well as by its beautiful red color. It has a sort of leathery covering in the cells, to which the Polypi adhere. In the soft rind which surrounds the axis there are small lime-needles, and outside these the nets of the common canals which the little creatures weave.

The Polypi consist of a soft gelatinous substance. When they sit undisturbed in their cells, one can see distinctly, by means of a microscope, that each possesses eight soft, three-cornered, leafy feelers, which are notched on each side, and situated in a simple circle round the mouth, by means of which they catch their food, and convey it to this aperture. If one of these feelers is touched ever so slightly, this act is sympathetically conveyed to each creature in the Coral hive. There seems to be among naturalists a conviction that the Coral insects, or Polypi, possess a common feeling, which by some wonderful organization vibrates through the whole root or axis of the Coral, so that both insect and web become as it were, one organized body. Although the Polypi shew such a remarkable sensitiveness, it has never been discovered that they possess nerves or any of the five senses. Their digestive organs are developed only in the smallest degree. In the common living Polypi, as in the case of the Precious Coral, the food goes into a hole in the stomach, and is there well mixed with water, and circulated hither and thither in little vessels, and so conveyed to the whole mass of Polypi, which are in direct communication with each other. The nourishment of the Polypi is derived from tiny creatures, and particles of plants found in the water. They have a great dislike to the light, and to a disturbance of the water, either one or other of which will drive them suddenly back to their cells.

The home of the Precious Coral is the Mediterranean, more especially on the African coast. It is formed in clefts of the rocks by the creatures themselves—a very tedious operation, indeed, when we consider that it is found at a depth of 700 feet.

Obtaining the Coral is quite as fruitful a source of traditions and fairy

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tales among the fishermen of the Mediterranean, as the buried treasures in the hearts of the mountains to the Germans.

The Coral fishery is carried on with much zeal and energy in many places, but especially on the coasts of Tunis, Algiers, Corsica, the Red Sea, Persian Gulf, and Sicily. On the African coast, which for centuries has been most celebrated for its Coral, is the sea-port of Calle, or Kalak, where the trade is most successfully carried on. Although the fishery has for years been worked by Corsicans, yet this paticular industry has been taken up by French energy. In the year 1450, France had an establishment there whose occupation was, above all things, the Coral fishery. It was conducted by a company who received the privilege of working it, provided they employed Provençals only.

In the year 1791 the fishery became free for all Frenchmen who traded with the Levant and states of Africa. Three years after a change in the arrangements took place. In 1802 England took possession of Calle, and restored it back in 1816. During this time the fishery was carried on vigorously, not less than 400 boats being devoted to this industry. In 1830, new arrangements were made, by which the Italians had to pay a duty for it, the French being exempted. Still, the Italian vessels predominated. Each Coral boat has twelve or thirteen sailors on board. The fishery begins in March and the fishers return home in October. Coral is obtained in the following manner: two iron rods about seven feet long, and having four prongs, are bound crosswise together, and wrapped up in a hemp about half-an-inch thick, and bound to this is a net-work bag. In the middle of the rods a weight of lead is fastened. This machine is let down by means of a cable, and when drawn up again, it catches the projecting Coral in the hemp, which is gently brought to the surface. Very clever and experienced divers will themselves bring up a strong branch of it. The Coral is next cut in specified lengths, and separated according to thickness, size, and beauty, and then, with or without polishing, sold. Coral is bored by steel needles, and in Italy this is done by hand, but in Leipzig, Karl Hoffmann has invented a machine for boring, and has thereby rendered it much cheaper. The larger the Coral and the paler its color, the more valuable it is in our day. The most beautiful production is called "Flower of Blood." The working of Coral is principally carried on in Marseilles, Genoa, and Leghorn. In the last-named city, as many as 300 work-people are employed, and most of the Coral goes to India, China, and Japan. In India the dark-red variety has always been valued. Every Oriental strives to get a string of corals for his turban, or at least sufficient to decorate the handle of his sword. They think that to leave their dead without ornaments of Coral, is to give them over to the hands of mighty enemies. There is scarcely an Indian to be found without at least one or two rows on one of his arms; those who can afford it have them on both arms, and the rich wear Red Coral on head, throat, and legs.

The Brahmins and Fakirs use Coral beads for rosaries to count their prayers. The Chinese mix the Red Coral with Jade beads, and wear them as ornaments for the neck and head.

The use of Coral in Europe, if we except England and Russia, is not large. At the commencement of this century, however, Coral of a beautiful blood-red, set in gold or silver, was fashionable for earrings, bracelets, necklaces, and baby rattles, in the nursery of the middle and upper classes.

The Pale Coral has been for the last twenty years rising in value; the rose tinted variety, when cut into a resemblance of the fanciful shapes assumed by Pink Pearls, obtains an enhanced value.

The price of the pale and sound Coral, is at present from £10 to £100 per ounce. The beautiful Rose-colored variety ranges from £100 to £200 per ounce; and the Red varies, according to color, from £2 to £20 per ounce.

It is often used for Cameos, being soft. At the sale of the Empress Eugènie's jewels, by Messrs. Christie & Manson, in 1872, a very fine suite

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of carved Coral and gold ornaments realized a high price: this probably may be explained by its having belonged to so distinguished a person. Fine specimens of carved Coral are not at all uncommon.

Coral was formerly in great repute as a talisman against enchantments, witchcraft, thunder, tempests, and other perils. It was consecrated to Jupiter and Phœbus.

It would not be wise to say that Coral either has lost, or will permanently lose, its share of popularity. It was only as the competitor of Wisdom that it was said, "No mention shall be made of Coral, or of Pearls, for the price of Wisdom is above Rubies."

General Remarks upon the term "CARAT."

The word Carat is probably derived from the name of a bean, the fruit of a species of *Erythrina* which grows in Africa. The tree which yields this fruit is called by the natives "Kuara" (Sun), and both blossom and fruit are of a golden color. The bean or fruit, when dried, is nearly always of the same weight, and thus in very remote times it was used in Schangallas, the chief market of Africa, as a standard of weight for gold. The beans were afterwards imported into India, and were there used for weighing the Diamond.

The Carat is not of the same weight in, all countries, for instance :—

One Carat in	England	is equal to	205,4090	milligrams.
„	France	„	205,5000	„
„	Vienna	„	206,1300	„
„	Berlin	„	205,4400	„
„	Frankfurt-on-Maine		205,7700	„
„	Leipzig	„	205,0000	„
„	Amsterdam	„	205,7000	„
„	Lisbon	„	205,7500	„
„	Leghorn	„	215,9900	„
„	Florence	„	195,2000	„
„	Spain	„	205,3930	„
„	Borneo	„	105,0000	„
„	Madras	„	207,3533	„

72 carats make ... ... One Cologne oz.
151½ carats make ... ... One English oz.

The ounce weight is used for weighing small, and Baroques Pearls, Coral, Peridots, and rough garnets.

PLUMBAGO MINES OF CEYLON: BLACK LEAD.

Perhaps some of our readers will be interested in a description of the plumbago or black lead mines of Ceylon, at least of those which exist in the Pasdum and Rygam Korales in the district of Kalutara, the two great Korales which supply the English mart with this very useful mineral. Although the country abounds with minerals of all kinds, plumbago is the only mineral which is exported in very large quantities to Europe. It is to be found chiefly in Pasdum Korale, but there are also some very valuable mines in the adjoining Korale and at Galle. The natives, as we are all aware, have no idea as to where minerals exist, the discovery of it depending entirely on mere chance. Since the Survey Department was organised, and Crown lands surveyed on a large scale for sale, the natives have learnt that the surveyors can put them in the way of buying plumbago lands, and accordingly these officers are not a little pestered for information on this point. That never failing index, the needle, always indicates in a greater or less degree the existence of minerals in the bowels of the

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earth, and we recollect hearing of a surveyor going out some months ago to survey a block of land purchased at the Colombo Kachcheri, and experiencing the utmost difficulty in bringing the theodolite to bear on a point owing to the fluctuation of the needle, which was dancing a kind of jig in the box. The instrument had to be shifted and fixed over and over again before it could be turned to any use. Sure enough he shortly afterwards discovered plumbago at the spot, not a valuable mine, but enough to influence the needle.

As a rule, if a native finds a plumbago mine (while, perhaps, sinking a well or digging a hole), he invites the wealthiest to join him in working it. If it happens to be Crown land, application is made to the Government Agent for a lease of one acre, which is granted after the usual disgustingly tedious forms are gone through. If the place is reported to be good, rival applicants start up, and all the applications are referred to the Mudaliyar of the Korale, who of course exercise a potent influence in the disposal of them. Generally the Agent gives it to the right man, that is to say, the first applicant. The lease having been executed at the Kachcheri, as soon as the dry weather sets in, operations commence, which is generally in January. After consulting the wiseacres of the village for the usual lucky hour, the first clod of earth is removed with as much ceremony as attends the laying of the foundation stone of any public building. Then the digging commences in right good earnest. The usual plan is for the proprietor or Government lessee to invite the villagers to quarry. If the prospects are cheering, the ground owner gets one-fourth of the yield of each pit; if otherwise, his usual share is one-fifth. It often happens that a digger, after much toil, is lucky enough to light upon a vein of plumbago; he goes on pumping out the water, and quarrying as fast as his unwieldy instruments would permit him. He fancies he had made a fortune, and speculates on the glorious future before him. His hopes, however, are often short-lived; to his utter dismay he finds either that the vein runs into his neighbour's pit, or that the plumbago is exhausted. We can give an instance of "ill luck," as he called it, which attended a well-to-do native of Rygam Korale in quarrying for plumbago. He leased out a piece of land from the Government Agent somewhere in Odoowere, and went on working for many years, spending nearly 200*l*. on the speculation. Occasionally he was buoyed up with hopes of ultimate success by the discovery of small veins of the mineral. He persevered in quarrying and quarrying, and quarrying, until he spent his last shilling, and eventually gave up the task from sheer inability to carry it on for want of funds. Shortly after the land was surveyed and sold by Government to a wealthy native of Moratuwa, who in less than one year realised a fortune.

It is difficult to fancy how soon the vast dreary jungle is transformed into a smiling village when plumbago operations are carried on on a large scale. Cooly lines rise here, there, and everywhere, an enterprising boutique-keeper sets up a shop with a large stock of rice, umblakade (dried Maldive fish) and salt, and arrack is also smuggled in from the adjoining tavern and sold in large quantities. We can imagine the labourers looking jolly after striking work, and on pay-day, at the end of the week, making a "Saturday night" of it.

The merchants who buy and export such large quantities of the mineral will not grudge giving the miners a reasonable value for their plumbago, if they only know the difficulties which exist in the excavation of the mineral. Using the rude implements with which they are familiar, they often sink from pure exhaustion, what with the hot burning sun over them, the thermometer at 80 deg. or 88 deg., and the coolies have to carry basket-loads of earth over a flight of slippery steps some forty to fifty feet in single file. If one man slips, as he often does, down come the others like so many ninepins

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The greatest difficulty the miners have to encounter is water. This element, which is so abundant in Ceylon, is the great drawback to the sucessful quarrying of plumbago. Buckets are resorted to, and latterly the more enterprising miners have taken to pumps. The amount of manual labour required to drain a pit of sixty by eigty and from forty to fifty feet deep must, therefore, be very great. But nevertheless, it is done, and hence it is that miners seldom make anything beyond a small profit in their speculation. It is a mistake to suppose that plumbago is found on the surface. One seldom meets with a vein, or "illeme," as the natives call it, excepting below thirty feet, the layer seldom exceeding two feet in thickness. Of course, there is great rejoicing when a good layer is found, and picked men are sent down with long pointed knives to break it up into as large blocks as they can conveniently do, which are placed in closely-plaited baskets, and the coolies have to take them to the store-room over the slippery steps. When perfectly dry, the pieces are picked, soaked, and sized, and sent to Colombo, the dust of course, which preponderates, being separately packed. It is hard to give a description of a plumbago mine. It is a large hole, if we may so call it, divided into compartments with flights of steps like galleries. The scene is very picturesque when the human hive are at work. The plumbago pit at Pellepittiagode in Pasdom Korale is the largest we ever saw, and we are told the largest in the island. Plumbago was first discovered there some fifty years ago, and the proprietors worked at it by fits and starts, and latterly realised a handsome profit. The pit now is as large as a little lake, and quite deep enough for a vessel of four hurdred tons burthen to anchor safely in. The large prices which plumbago realised latterly has given an impetus to the trade. The royalty has been raised from 14s. to 16s. the ton, notwithstanding which it still flourishes. We fear there will be a great falling off this year owing to the unsatisfactory state of the market in England. If modern art can only be brought to bear on the quarrying operations, proprietors will, we are certain, make a handsome profit in the speculation.—"Ceylon Examiner."

A VISIT TO THE WORKS OF THE PATENT PLUMBAGO CRUCIBLE COMPANY.

By J C. Brough.

From the "Technologist," *No. XLVI.*, *Vol.* 4, *May 1864.*

Crucibles have been in use for melting and refining metals from that distant point of time when man exchanged his stone hatchet and bone chisel for implements of bronze. The earliest melting-pots were doubtless made of the plastic and infusible substance clay, and there is no reason to suppose that they differed essentially from the earthen crucibles now commonly used in our foundries.

As an instrument of scientific research, the crucible has held an important position for at least a thousand years. It was constantly used by the first alchemists, and may indeed, be truly styled the cradle of experimental chemistry.*

At the present time crucibles of one form or another are extensively employed by the refiner of gold and silver, the brass-founder, the melters of copper, zinc, and malleable iron, the manufacturer of cast steel, the assayer, and the practical chemist. They are made in many different shapes and sizes, and of many materials, according to the purposes for which they are intended. For certain chemical experiments requiring high temperature, vessels

* The word "Crucible," from the Latin *crux—crucis*, recalls the alchemical practice of making the vessel with the protective sign of the Cross.

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of platinum, porcelain, and lime are adopted; but for ordinary metallurgical operations "clay crucibles" and "plumbago crucibles" are exclusively employed. We have now to confine our remarks to these two important classes of crucibles.

On examining a clay or plumbago crucible, we find nothing to excite our surprise. It seems to be merely a rough specimen of pottery that might be easily imitated. Yet the successful makers of crucibles are so few that they might almost be counted on the fingers of two hands. When we take into consideration the qualities which are required in a crucible to enable it to pass victoriously through the ordeal by fire, the paucity of good makes becomes intelligible. The crucible should resist a high temperature without fusing or softening in a sensible degree; it should not be liable to break or crumble when grasped with the tongs, and it ought to be but little affected by the chemical action of the ashes of the fuel. Again, it may be required to withstand the corrosion and permeation of such matters as melted oxide of lead. In some cases crucibles should resist very sudden and great alternations of temperature, so that they may be plunged while cold into a furnace nearly white hot without cracking. In other cases, they are merely required to resist a high temperature after having been gradually heated. Some crucibles are specially remarkable for one quality, and others for another, so that in selecting them the conditions to which they will be exposed must be kept in view. The crucibles which present the finest combination of good qualities are those from which the Patent Plumbago Crucible Company takes its name. They support, even when of the largest size, the greatest and most sudden alternations of temperature without cracking; they can be used repeatedly, and their inner surface can be made so smooth that there is no fear of the particles of metal hanging about their sides. Their first cost is necessarily high, as plumbago is an expensive raw material; but the fact that they may be used for a great number of meltings, makes them in reality cheaper than the ordinary clay pots. As fire-clay contracts considerably when exposed to a high temperature, it cannot be used alone for large crucibles. The so-called "clay crucibles" are made of a mixture of the plastic clay and some other substance, such as highly-burnt fire-clay, silica, or coke, which counteracts in a measure the evil due to contraction, and so lessens the tendency of the vessels to crack. The large Stourbridge clay crucibles so extensively employed by the brass-founders of Birmingham contain both burnt-clay and coke. The Cornish and Hessian crucibles are made of peculiar kinds of clay in admixture with sand. The great superiority of the plumbago crucibles over these can be easily accounted for by the fact that graphite or plumbago is the most infusible of all substances known, and at the same time a material that can be thoroughly incorporated with the clay without impairing its plasticity.

The works of the Patent Plumbago Crucible Company cover a large space of ground at Battersea, and have a good river frontage. As we proceed along the lane which leads from near Battersea Bridge, we find that the ground gets blacker and blacker, and before we reach the threshold of the office we notice the familiar black-lead polish beneath our feet. Passing a regiment of clerks, we enter the private office of the manager of the works, where we put on a very large coat and a very old hat, which are kept for the use of clean visitors. There are many things in this little office which attract our attention. The walls are covered with testimonials from British and Foreign mints respecting the excellence of the Company's manufactures, with here and there a prize medal. The International Exhibition of 1862 is recalled, not merely by the Prize Medals awarded to the Company for Crucibles and Black-leads, but also by the splendid collection of samples of Plumbago, which formed such a striking feature in Class I. In this collection every quality of plumbago is represented by specimens from all the

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most celebrated mines, particularly those of Ceylon, Germany, Spain, Siberia, Canada, Finland, and Borrowdale. We learn from the manager that some of the samples would not be adapted for the manufactures of the Company. The Siberian plumbago, for instance, contains too much iron, and although this could be entirely removed by the Company's patented process for purifying plumbago, it is found cheaper to work with the Ceylon plumbago, which contains but little iron.

Before we leave this snug office for the busy factory, we will jot down a few notes on plumbago, or, to use its more correct name, graphite. The old minerologists, misled by its remarkable metallic lustre, placed graphite among the metals, and at the present time there are doubtless many persons who accept "black-lead" as an appropriate name for this substance. In most dictionaries graphite is defined as "carburet of iron," in accordance with the opinion formerly held by most chemists that it was a compound of carbon and iron. This definition is now known to be incorrect, for although iron is generally present in graphite, it must not be regarded as an essential constituent, any more than the silica or alumina which usually accompanies it. The iron, silica, and alumina, when present, are simply in a state of mixture, and not chemically combined. Graphite is one of the forms of *carbon*, that Protean element which also occurs native as the sparkling diamond and the black and lustrous anthracite, and which also appears in the familiar shapes of charcoal, coke, and lamp-black. According to Dr. Wood's analysis of a sample of the graphite used of these works, it contained upwards of 98 per cent. of pure carbon, the remainder being with mere traces of iron and alumina. Few samples have been found to contain less than 95 per cent. The variform character of carbon is exhibited by graphite itself, for it is sometimes crystalline and sometimes amorphous. The crystallized, or foliated graphite, is found occasionally in six-sided tabular crystals, but commonly in foliated or granular masses. It is chiefly obtained from Ceylon, where it is found imbedded in quartz. It is also found near Moreton Bay, in Australia; in the states of New York and Massachussets, and in Siberia. The amorphous graphite is that variety to which the terms "plumbago" and "black-lead" are ordinarily applied. It is much softer than the crystalline graphite, and makes a blacker streak on paper. Formerly it was obtained almost exclusively from Borrowdale in Cumberland, but the mine there is nearly exhausted, and we believe is no longer worked. The bulk of that used at present comes from Germany, principally from Griesbach, near Passau. Both varieties are used in the manufactures of the Company; the crystalline for crucibles, and the amorphous for polishing powders.

The consumption of Ceylon graphite at the Battersea works has had an extraordinary effect upon the price of the article. When the Company commenced business it cost about £10 per ton, but now it cannot be bought at double that price. In Ceylon, we hear that applications to dig graphite are daily on the increase, notwithstanding the rate of 14s. per ton which has to be paid as royalty at the Colombo Kachcheri. The following figures giving the amount of revenue collected at Colombo and Galle, on account of royalty in 1862 and 1863, clearly show the extraordinary increase in demand for Ceylon graphite:--

	1862.			1863.			Increase.		
	£	s.	d.	£	s.	d.	£	s.	d.
Western Province ...	472	4	4	1,272	10	2	800	5	10
Southern Province ...	112	2	8	282	8	5	170	5	9

The total quantity of graphite exported from Ceylon in 1862 was 40,195 cwt., of which no less than 84,730 cwt. was shipped to Great Britain. The Customs returns for last year have not reached us. We do not wish

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it to be understood that the Patent Plumbago Crucible Company use up all the Ceylon graphite brought to the United Kingdom, but it is well known that they are the principal consumers. We must now take leave of chemistry and statistics, and see what there is to be seen at the Black Potteries.

We commence our tour of inspection at the Receiving Stores, where we are shown the stock of raw material, which comprises at present about 2,000 casks of graphite, each one holding from four to five cwt. The heads of a couple of casks are broken open, in order that we may compare the hard iron-grey fragments of the Ceylon graphite with the black, dull, friable lumps of the German variety. A piece of the latter pressed between the finger and thumb feels pleasantly soft, and flattens readily into a lustrous cake. From the Stores we pass to the Engine-House, to take a peep at the prime mover of the machinery employed on the factory. One horizontal engine of 25-horse power serves to do all the work that does not require skilled hands.

The Grinding Room contains several mills of different construction for grinding and mixing the materials, of which the crucibles are formed. In one corner we see two huge stones chasing one another round a shaft, and pitilessly crushing the hard lumps of dried clay that are thrown in their path. Here we see a powerful mill for grinding the graphite; and here again, an ordinary pug-mill for incorporating the graphite with the clays. The noise made by these machines is almost unbearable, but it is not only the noise we have to put up with. A brisk rattle is maintained by a number of workmen who are occupied in sorting the pieces of graphite into different sizes and qualities by the aid of metallic sieves. When the graphite is reduced to powder, it is conveyed to the upper-floor by an endless band-lift, and sifted by a contrivance similar to an ordinary flour-dressing machine. One of thess machines is provided with a sil gauze drum of remarkable fineness, and is reserved for the preparation of plumbago for anti-friction purposes.

Following the graphite to the upper-floor, we enter the Mixing Room, where the most important operation in the crucible manufacture is performed. A number of large bins, each containing a distinct variety of clay in powder or a certain quality of plumbago, are ranged round the room. Upon the proportion of these several ingredients taken to form the mixture, or "metal" as it is technically termed, the quality of the crucibles depends. The actual proportions of Stourbridge and other clays used are of course kept secret. The ground graphite having been mixed with the clays, the whole is wetted with a sufficient quantity of water, and allowed to soak for some time. Having been "pugged" in the mill, the tempered "metal" is formed into blocks, and then placed into a store-room, where it is allowed to remain for several weeks.

We now enter the Potter's Room, where the crucibles are fashioned. This room might be a part of any large pottery were it not for the funeral hue of everything around. On each side are ranged the lathes or wheels, all driven by steam-power, but resembling in other respects the potter's wheel of the earliest ages. Let us watch the growth of one large crucible. The "thrower" takes the necessary quantity of "metal" and submits it to the operation of "wedging," which consists of tearing or cutting it into two pieces and striking them together again with great force. This he repeats until the metal becomes perfectly tractable. He then dashes the mass upon the revolving disc of his lathe, and presses it with his wet hands till it assumes an irregular conical form. He then makes it take a variety of form with the object of getting rid of all air bubbles. It is impossible to follow the mass through its numerous changes, but suddenly, when we least expect it, it takes the shape of the crucible. The shape is very rude at first, but

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under the skilful hands of the thrower, it soon becomes beautifully symmetrical. A wire guide is fixed at a certain height above, and at a certain distance from the revolving mass, and to this the thrower gradually brings the edge of the crucible. With this simple guide he can make a dozen pots resembling each other so perfectly in shape and size, that the most experienced eye can hardly detect any variation in them. The skittle-pots are made in precisely the same way, but are contracted at the mouth after the inside has been properly shaped. Many of the fire-resisting goods manufactured by the Company are shaped by moulds or by the aid of modelling tools. One of these miscellaneous articles which we see in course of construction is a large bath, five feet long by a foot and a half wide, intended to hold molten zinc. This we are told is for a French order.

We now follow the pots to the Drying Room. Through the centre of this room the upper part of one of the kilns passes, and the heat which would otherwise be wasted is thus applied to a useful purpose. Here we find regiments of pots undergoing the drying process. Many of them have the graceful form of the once-celebrated Picardy pots, and are intended for the French mints. Though unbaked, each article that has remained sufficiently long in the room gives a clear metallic ring when struck.

The kilns are large conical chambers like those of ordinary potteries. The goods to be "fired" are packed in cylindrical cases of fire-clay called "seggars," and these are piled one above the other in the kiln like the basaltic columns of Staffa, and are luted closely together. These seggars protect the goods from the action of the air, which at a high temperature would have the effect of whitening their external surfaces, and so rendering them unsightly. We have the good fortune to be present as the workmen are engaged in emptying a kiln. We see that the crucibles come from their fire-clay cases exactly as they are sent out from the works. The absurd practice of giving plumbago crucibles a factitious polish and smoothness generally followed by continental makers is not adopted by the Company.

From the kiln the goods are conveyed to the Store Room, or to the Packing Room if they are to be shipped at once. The goods are nearly always packed in old sugar hogsheads, which are strong, large, cheap, and plentiful. Turning out on to the wharf we see thirty of these hogsheads packed ready to be shipped for Vienna; and lying alongside, 150 cases containing crucibles for the Italian Government. These orders, not by any means unusual in magnitude, will enable our readers to form an idea of the scale upon which the operations of the Company are conducted.

We now cross the yard to the workshops of the Clay Department, where various descriptions of crucibles are manufactured. The larger sizes, as in the case of plumbago crucibles, are made at the potter's wheel, but the smaller, in which the Company can successfully compete with the best French makers, are fashioned by beating the clay upon box-wood mandrils. The so-called "white-fluxing pots" are really beautiful specimens of earthenware, and are acknowledged by the best authorities on metallurgy to be very refractory, and to withstand the action of fluxes in a most remarkable manner. Every pot is made by gauge, and each moulder is consequently provided with a great number of pattern ribs cut from box-wood and ebony. The little crucibles used in assaying almost equal the German porcelain crucibles in thinness and smoothness. The smallest are not much more than an inch high. Besides crucibles, all kinds of clay instruments used in assaying are here manufactured, such as scorifiers, roasting dishes, and muffles. The convenient clay furnaces used by assayers, dentists, and experimental chemists, are also made in great numbers.

Let us now turn back to the Store Rooms and look at a few of the curiosities that are to be found there. We have just been speaking of a

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crucible about an inch high. Here is one of the patterns supplied to the Royal Mints, intended for melting 600 pounds weight of silver. Here again is another plumbago pot, made specially for zincing the Armstrong shot, and which will hold 800 lbs. of molten zinc. The medium sized plumbago pots now so extensively employed for melting silver, gold, copper, brass, and malleable iron, are, of course, the most important products of the works. All the pots are numbered according to their contents, each number standing for one kilogramme, or a little over two pounds; thus—a No. 2 crucible contains two kilogrammes; a No. 3, three kilogrammes, and so on. Covers, stands, and stirrers of plumbago are kept in stock, with every conceivable article of fire-clay, from the huge glass pot down to the humble fire-ball for the parlour grate.

The graphite imported by the Company is not used solely in the manufacture of melting-pots and metallurgical apparatus. A good proportion of this valuable raw material is prepared for domestic purposes, and sent from the Battersea Works in the form of ordinary "black-lead." As this article is used wherever there is a grate or stove to be kept bright, its annual consumption must be very large. There is no substitute for it—nothing that can be employed in the same way to polish and protect the iron-work of common fireplaces. Without the factitious lustre produced by the action of "elbow-grease" on black-lead, the most elaborate kitchen range would soon become unsightly, the trim parlour grates would blush with rust, and the cottager's "wee bit ingle" would leave off "blinkin' bonnily."

The various qualities of black-lead which the Company sends into the market under different fanciful names are all prepared from graphite or plumbago, and nothing else. The higher qualities are distinguished from the lower by their superior fineness, softness, and lustre; but chemically they are identical. The article sold under the sentimental name of "Servants' Friend" at 28s. per cwt. is quite as pure as the "Prize Medal Lustre," which fetches double the prize, or "Halse's Roman Lustre," the best quality of black-lead manufactured by the Company. Again, the analytical chemist would fail to detect any essential difference between either of the above-named products and the article labelled "carburet of iron," in remembrance of the exploded opinion respecting the nature of graphite. How comes it, then, that, one quality is so much superior to another? The explanation is simple enough. The differences in the manufactured article may be traced to certain variations in the physical properties of the raw material. Thus one sample of graphite may be soft and lustrous while another, equally pure, may be hard and dull. The variations are subordinate to the distinction between amorphous and crystallized graphite, to which we have already referred. For making domestic black-lead, the amorphous or soft graphite is almost exclusively used.

The separation of the different qualities of graphite is a labour which demands great experience and judgment, and can only be successfully performed by the old hands. The best pieces are soft and unctuous, perfectly free from grit, and capable of receiving a very high polish. The worst pieces, technically called "gruffs," are, on the contrary harsh, gritty, and deficient in lustre. The latter are only employed for making "leads" of the lowest brands. The numerous intermediate qualities are distinguished one from another by characters which are only apparent to the experienced eye.

The manufacture of black-leads includes three distinct operations—grinding, sifting, and packing. At the Battersea Works the first operation is performed by means of a large mill driven by steam power. The ground "lead" is conveyed to an upper floor by an endless-band elevator, and is then sifted through the finest silk in the simple dressing machine already noticed. The packing is chiefly done by boys, who work with marvellous

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rapidity. The powdered black-leads are done up in neat packets, in quantities from two ounces upwards; they are also packed in 1-lb. tin canisters and in wood boxes. Papers of various colours are used to form the small packets, so that the different qualities may be readily distinguished. A paper covered on one side with burnished black-lead is employed for wrapping up some of the higher qualities.

Two descriptions of "blocked black-lead" are manufactured by the Company. The blocks are formed by pressing the powdered and sifted graphite into suitable moulds by the aid of machinery, very similar in construction to that employed for making bricks, though, of course, on a much smaller scale. There are two blocking machines constantly at work; and the number of little bricks they turn out annually would amply suffice for the building of a Lilliputian city.

The organization of labour is thoroughly understood at the Battersea Works. There is a place for every man, and every man is in his place. A strict code of rules is enforced by fines; but these fines are paid over to the Fund of the Workmen's Provident Club. We have been over many great industrial establishments, but have not seen any better managed than this crucible factory.

A few days after writing the above we paid a visit to the establishment of Messrs. Brown and Wingrove, the refiners to the Bank of England, where we saw a hundred ounces of silver poured out from a plumbago crucible which had been used again and again. Here, indeed, as at many other great establishments, the Patent Plumbago Crucibles are alone used. We were informed by the courteous manager of the refinery, that the pots never cracked, but gradually became thinner until a point was reached, when it would be unsafe to trust a charge in them. He assured us that 50,000 ounces of silver and upwards had been melted in one 1,000 oz.-pot. We were glad to receive such good testimony to the value of the plumbago crucibles, for all that we saw at Battersea gave us a most favourable impression of the manufactures of the Company.—*Extracted by the "Engineer," "Mechanics' Magazine," "Mining Journal," "Ironmonger," "Chemist and Druggist."*

GOLD-PROSPECTING IN CEYLON :—TESTS AND LOCAL EXPERIENCE.

Nuwara Eliya, April 11th, 1881.

Dear Sir,—If your correspondent "Sore Fingers" will digest the "black sand" in dilute *nitro-muriatic acid*, decant it carefully and add a few drops of a solution of *proto-sulphate of iron*, he will readily ascertain the existence of gold by its being precipitated in a metallic form.

The dilute *nitro-muriatic acid* may be composed of *1 part muriatic acid, 2 parts nitric acid, 2 parts water.* The vessel containing the subject of the experiment should be placed in warm water.

The simplest way, however, is to wash the sand in a small pan with sloping sides and a flat bottom, passing it off gradually with the water, when, if the operation is conducted skilfully, whatever gold there may be will remain in the angle of the pan.

With regard to the "black sand" in question, it is very abundant in this neighbourhood, being found in streams and on and below the surface in every direction. I have hitherto found no gold with it, but this is not a thing to be surprised at, for gold is four or five times heavier than the sand and would naturally seek a much lower depth. If found together it would be owing entirely to some local circumstance, such as a light soil resting on a

bed of clay or rock, or in watercourses where some rock or boulder has arrested the course of the stream forming a pool where heavy substances would sink and collect. This sand is—as far at I have been able to determine in the absence of some necessary tests and re-agents which I am awaiting—an oxide of manganese, probably the mineral *Psilomelane*, and may prove to be valuable.

I tested a piece of the supposed gold-bearing quartz from the Hog's Back tunnel the other day, but found no trace of the precious metal. The pyrites seemed only too pure. I may, however, have had a poor specimen to deal with, and I intend trying others which I have by me.—Yours faithfully,

W. FREDK. MAYES.

THE GOLD-BEARING DISTRICTS OF SOUTHERN INDIA.

To the Editor of the Melbourne "Argus."

SIR,—Having visited the Devalah gold-mines some three and a half years ago, I am not surprised at the accounts now published of the success of the first large experiment in quartz crushing. As I was the first Indian editor who had gone to see the operations of the Alpha Mining Company, Mr. Minchin, Mr. Ryan, and the other directors were present to receive me, show me over the works, and afford full information regarding their operations and their success so far. At parting they presented me with a piece of gold-bearing quartz, computed to contain about two guineas' worth of the precious metal. The fractured surface of this specimen was covered with specks of gold, quite obvious to the naked eye, while a magnifying-glass brought out the real richness of the stone. As I have handed the specimen to Mr. Cosmo Newbery, who has kindly promised to report on its character and value, those having interest in the subject can see the quartz, and when the pressure of his engagements in connexion with the Exhibition awards is lightened, I have no doubt Mr. Newbery will confirm my opinion as to the promising character of the stone. As the means of the original Alpha Company were limited, they had not been able to run a shaft much below the surface, so that the quartz which they were crushing had still a large portion of pyrites in its composition, and had patches of a rusty brown colour, such as I have seen on some of the specimens of auriferous quartz shown at the Melbourne International Exhibition. Having read the reports by Mr. King, of the Indian Geological Survey, on the Wynaad quartz reef, and seen for myself, I formed and published the conclusion, which I have never seen reason to qualify, that deep shafts would lead to the finding of stone exceptionally rich in ore and much less mixed with pyrites than the quartz on or near the surface. The results already obtained seem to justify the opinions I had formed, and there can be little doubt that there is a great future for Southern and South-western India as a gold-yielding region. It has been that to a certain extent from far-back antiquity. It was interesting to see the surface of the out-cropping quartz dotted with pot-holes, some of them probably thousands of years old, in which the natives of Malabar had, since the time of Solomon, and probably long before the era of the monarch in whose time silver was not accounted of, because gold was so abundant, conducted their simple crushing operations. Granted that the Ophir of the Hebrew scriptures was not a particular country, but a region, there seems little reason to doubt that the Malabar coast of India, as well as the Island of Ceylon (Taprobane), were included in the region whence gold of Ophir, with apes and peacocks, was brought. The fact remains that the names for apes and peacocks are not Hebrew words, but the Tamil names by which monkeys and peacocks are still called in Southern India.

More interesting to a large class of your readers than the discussion regarding Ophir is the now ascertained existence of a wide extent of rich auriferous quartz in Wynaad and Mysore. The danger is that the accounts received may lead to a "rush" of miners from Australia to the

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Indian gold-fields. I feel it a duty, therefore, to a country where I have experienced so much kindness, to utter a word of warning. Devalah, the scene of the successful experiments now reported, is exceedingly insalubrious for a considerable portion of each year. The district lies at the base of the great Nilgiri (Blue Mountain) range, at an elevation of 2,500 feet above sea level, while the plateau in which the neighbouring sanatorium of Ootacamund is situated is 7,000 feet altitude, with peaks rising, as in the case of Dodabetta, to considerably over 8,000 feet. As is the case with all places so situated in India, and even in Ceylon, Devalah is haunted by malarious fever—the "jungle fever" of the tropics, from which the northern regions of even this favoured land of Australia are not exempt. What the deadly "terai" of the Eastern Himalayas is to the delightful hill region of Darjeeling, which looks down on the rich but pestiferous plain below, that Devalah, with most of the Wynaad, is to the Nilgiri (Neilgherry) mountain ranges, in which the fine sanataria of Coonoor (6,000 feet elevation) and Ootacamund (7,000 feet) are situated. Bracing climate and pestiferous are separated by only a few miles of distance. Superior elevation is an important factor in the difference, but there are other conditions. The soil at the bases of the Indian ranges consisting of the *débris* of the mountains, washed down during thousands of years, and of humus resulting from decayed vegetation, is rich, but gives out pestiferous gases when stirred. The rainfall, too, is very heavy, but badly distributed, the great bulk of 200 inches or more falling in four months out of the twelve, the remaining eight being generally distinguished for, but seldom broken drought. That condition alone (of rainfall) involves insalubrity, and the greater salubrity of the mountain region of Ceylon is due to the more equal distribution of the monsoon rains. Of course there is the qualifying circumstance that in the Wynaad, a healthy and health-restoring region is close to the fever region, and could be rendered easily accessible by a winding railway (I have strong objections to the ladder-railway, Rhigi pattern, by which it is proposed to connect Ootacamund with the "low country"). It is possible that rich quartz, brought to the surface during the healthy period of the year, might pay the expense of transport up to a healthy altitude, there to be crushed. In that case the digging, mainly by natives (who, though they suffer, do not suffer so much as Europeans from fever), might go on all the year round, the crushing and other operations being conducted above the fever region by Europeans. This is a crude idea of mine and may probably be pronounced impracticable. If European miners seek employment in the Wynaad, they must take the risks of the position, looking at the qualifying fact that a sanatorium is close at hand. It is right to add, however, that some constitutions, once affected by a full dose of the fever poison, are never able to throw it off, even by the generally potent aid of quinine, and "sending the patient into purer air." Some of the Mysore districts are healthier than those of Malabar, but it must be understood that besides the ordinary influences of a hot climate in enervating Europeans and rendering them unfit for manual labour, the dangers of malarious fever and the consequences which follow are present and formidable. It is possible, to doubt, that the auriferous reefs may be followed up to the healthy altitudes, but the vast proportion of the reefs are in the sub-ranges—low, hot, and generally feverish.

Gold prospecting is now going actively forward in Ceylon, and with good hopes of success. Gold in minute particles is abundant in some of our rivers, and the natural conclusion is that deep digging towards the sources of those rivers may reveal quartz rich in gold. A little more than a quarter of a century ago we had our "rush" in the Indian Island. A couple of diggers from Australia reported gold in the Maha Oya, a stream turbid and unhealthy from the sea almost up to its source. Persons flocked to the scene and found gold dust, but no nuggets, and in a few weeks all were dispersed by fever. The Australians, subsequently, tried digging up in our sanatarium (Nuwara Eliya, 6,200 feet altitude), and Sir Samuel Baker, who was resident there at

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the time, has in his books on Ceylon strongly expressed the opinion that if means had been provided to sink shafts to a proper depth, success would have been the result. The question will soon be set at rest, and I trust Ceylon will soon take rank amongst the gold-yielding countries of the world. Any amount of "black" labour is available in Southern India and Ceylon, and what I wish to impress on the mining class here is that neither India nor Ceylon is "a good working man's country." The true function of the white man in the tropics (and I do not except the tropical region of Australia) is to act as a director of Asiatic labour; he to find and exercise brain power, they to supply the bone and sinew. For a certain number of intelligent, educated European miners suitable employment will, no doubt, offer in connexion with the Indian gold mines. But a "rush" to India of labouring miners is greatly to be deprecated, because sure to be disastrous, from the insanitary conditions I have felt it my duty to describe.—Yours, &c.,

A. M. FERGUSON,

June 10, 1881. EDITOR, *Ceylon Observer.*

INDIAN GOLD MINING.

A "Practical Miner" writes to the *Mining Journal* :—

I have read in your valuable Jourual of July 9th, a communicated article on the Indian gold mines, written, I suppose, by some mining engineer who has had the necessary training and education to understand gold mining at a glance.

First, he says the character of the quartz in the mines of Wyaand and Mysore has a waxey or milky appearance, and it is entirely free from any ferruginous matrix—pyrites of iron. Now, Sir, I have worked in the most productive mines of both California and Nevada. My experience teaches me, if you wish to find good profitable gold mines you must find your lodes and reefs well charged with iron pyrites. In fact, all profitable gold mines on the Pacific Coast are found on large north and south ferruginous veins in slate, gneiss, greenstone, quartzite, etc. I never saw a profitable gold mines on the Pacific Coast or elsewhere in the pure compact quartz 60 feet from surface. I have seen gold mines in California—the Sutler Creek Mine which was profitably worked near 200 fathoms from surface, but the gold was associated with iron pyrites and a small precentage of galena. The celebrated gold mines of Nevada County, California—the Rocky bar Eureka, Allison's Ranch; French Lead, and Idaho Mines—which have been the best paying mines of California —were found in ferruginous lodes, some of them worked to a depth of 170 fathoms. I have seen in the pure compact quartz veins good deposits of gold near the surface, but never a mine that was worked profitably 50 feet from surface. At Sonora in Tuolumne County, I have known the clean quartz veins productive, 20 and even 30 feet from surface. My practical experience in gold mining tells me you may as well expect to find a profitable copper mine without sulphur as a profitable auriferous mine without iron pyrites. Australian gold mines have precisely the same characteristics, also the gold mines of Nova-Scotia, Brazils. The late Capt. Thos. Treloar, of the Don Pedro Mines, says the rich portions of the lodes are found more auriferous in the ferruginous matrix than elsewhere.

Secondly, your correspondent says in the Kolar district the ground is not broken up or disturbed by, I suppose, cross-courses or intersection of any other strata, but simply the reefs are confined between two well-defined walls of exceedingly hard gneiss, almost like a fine grained granite. Now, any practical gold miner would consider this an unfavourable omen for the production of gold. I have always found the veins most productive for gold near these interruptions, cross-courses, heaves and dislocations; they are the great irrigators of all metalliferous veins and rocks; without these disturbances the veins are

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seldom productive for any distance. All intelligent gold miners know from experience that the quality of the veins in California is dependent on the mysterious effects of the junction of rocks of different composition.

THE GOLD MINING COMPANIES OF SOUTHERN INDIA.

A handbook of the Indian Gold Mining Companies, posted up to July last, has been published by Messrs. Higginbotham & Co. It contains a list of the Companies; an alphabetical list of Directors; a list of the Mining Engineers; and the rules for Gold Mining leases in Madras, and in Mysore. The list of the Companies gives, in most instances the names of the Directors, the Secretaries, the Bankers, the Solicitors, the Consulting Engineers, the date of issue, the capital, the values of the shares, and the cost and area of the properties. We would have been glad if the compiler had gone a step farther, and favoured the public with a digest of the prospectuses of the Companies. It is likely to be interesting hereafter to compare promise with performance; for while on the one hand, the results of some of the Companies may exceed the sanguine expectation of the earliest pioneers of the industry, on the other it may be found that hope told a far too flattering tale to the promoters of several of the schemes. We have, however, been enabled to compile two useful tables from the information before us. In the first, we give a list of the Companies connected with Wynaad, and some particulars about them :—

THE WYNAAD COMPANIES.

Name.	Capital.	Price of Property.	Paid in Shares.	Area Acres.
Balcarres ...	£180,000	100,000	50,000	1,198
Carta Para ...	50,000	½ net pro.	...	300
Central Wynaad ...	100,000	62,000	33,000	1,560
Cherambadi ...	100,000	32,000	16,000	200
Cootacovil ...	100,000	60,000	32,000	300
Devalah Central ...	120,000	70,000	20,000	986
Devala Moyar ...	200,000	132,000	61,795	2,055
Devalah Provident ...	75,000	30,000	...	120
Dingley Dell ...	100,000	70,000	30,000	600
Ind. Consolidated ...	400,000	275,000	130,000	1,920
Indian Gold Mines ...	110,000	...	...	...
Do Glenrock ...	100,000	50,000	33,000	3,000
Do Grange ...	100,000	50,000	33,000	300
Do Kingston ...	130,000	91,500	43,333	270
Do Mammoth ...	150,000	70,000	...	1,500
Do Phœnix ...	150,000	85,000	33,000	800
Do Trevelyan ...	150,000	96,000	50,000	930
Needlerock ...	125,000	85,000	32,000	250
Nilgiri Gold ...	120,000	85,000	30,000	200
Parcherry ...	150,000	98,000	50,000	299
Rhodes Reef ...	190,000	130,000	50,000	50
Simon's Reef ...	170,000	55,000	...	...
S. East Wynaad ...	100,000	60,000	...	2,400
South Indian ...	100,000	47,000	...	1,200
Do Wynaad ...	100,000	65,000	32,500	677
Tambracherry ...	160,000	120,000	52,000	6,000
Wala Wynaad ...	75,000	45,000	15,000	500
Wentworth ...	120,000	80,000	40,000	2,027
Wynaad ...	R650,000	...	...	1,000
Wynaad District ...	£100,000	40,000	25,000	270
Wynaad Glen ...	60,000	...	...	80
Wynaad Perseverance ...	80,000	50,000	26,666	600

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The nominal capital of these Companies amounts to no less a sum than £4,030,000. To this we may add a list of the Companies working in the Kolar District :—

THE MYSORE COMPANIES.

Name.	Capital.	Price of Property.	Paid in Shares.	Area Acres.
Balaghat ...	R3,60,000	1,20,000	60,000	150
Colar ...	£150,000	40,000	...	320
G. Southern Mysore ...	75,000	45,000	...	150
Kaiser-i-Hind ...	R12,00,000	7,50,000	325,000	640
Madras ...	£135,000	85,000	25,000	320
Mysore ...	135,000	55,000	...	750
Mysore Reefs ...	120,000	75,000	30,000	320
Nine Reefs ...	100,000	60,000	33,000	300
N. Ooregum ...	120,000	75,000	40,000	320
Nundydroog ...	100,000	50,000	33,000	...
Ooregum ...	125,000	75,000	...	259

The nominal capitals of these Mysore Companies amount to £1,216,000. So the combined nominal capitals of the Indian Gold Mining Companies above-named, plus the R6,00,000 of the Southern India Alpha Company (now practically absorbed in the Indian Gold Mines Company of Glasgow) may be set down at £5,306,000.

One characteristic of the majority of these Companies will forcibly strike most persons who look through the Handbook, namely, that their head offices and Boards of Directors are in London, and they are almost entirely administered at a distance of five thousand miles from the mines. (One Wynaad Company, the Wynaad, has its head office in Bombay ; as also has one of the Mysore Companies, the Kaiser-i-Hind ; and another Mysore Company, the Balaghat is administered from Madras). The explanation of this is that as the promoters could not reasonably calculate upon getting the money they wanted in India, they had to resort to the place where the money was to be had for the asking. Doubtless, if the British public had looked askance at the schemes, few of the Companies would have been started. But while admitting that the promoters were wise in their generation in going far afield for the sinews of war, we consider that risk is run by attempting to direct the affairs of the Companies from London. The local management of mines has been found to work best in Australia and elsewhere ; and we see nothing in the new industry in India to justify the supposition, that this plan, which commends itself to common sense, can be safely departed from in this country. Moreover, very few of the Directors can be regarded as men who possess a practical knowledge of gold, or any other mining. There are one hundred and fifty-two of them, and the majority are retired officials. The gentleman who seems to have been most in request, is Captain W. B. McTaggart, formerly of the 14th Hussars. This ex-warrior, is a director of six Companies, namely, the Nilgiri, the Nine Reefs, the Nundydroog, the Mysore, the Madras, and the Great Southern of Mysore ; and in regard to five of these Companies he also occupies the position of one of the vendors of the land acquired. He is the son of a Madras merchant ; but we are unacquainted with his other qualifications to direct the working of half-a-dozen companies, whose capitals total up to £665,000. Presumably, a director should be none other than a man who is competent to direct; and we do not readily understand how such competency can be obtained without a practical knowledge of the business that needs direction. One might imagine from the list of directors in the Handbook that "any fellah" is good enough to join the Board of an Indian Gold Mining Company whereas,

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if people who know a good deal about gold; mining in Australia and America are to be believed, the directors of Gold Mining Companies ought not to be "guinea pigs," but men who have established a reputation for shrewdness and practice in the business of gold mining. The old proverb warns us that a "little knowledge is a dangerous thing" and not a few of the gentlemen whose names are before us might declare with truth, that since their minds are blanks with regard to mining they are not hampered with the dangerous modicum of knowledge referred to. But those Directors who are dummies are so many causes of weakness to the Companies under notice; for, as they become sooner or later conscious that they are at sea on the subject of mining, they are tempted to allow the entire management of the Companies to drift into hands of individuals, whose ability to undertake the task may be open to question though there may be no indisposition on their part to learn the business that they have undertaken; but in the absence of suitable training, the requisite experience may cost a good deal to acquire, and the shareholders will have the honor of paying the piper.

This is already being discovered in India, for some of the above-mentioned Companies have appointed to the charge of their mines, men whose qualifications for the responsibilities imposed upon them are less obvious than their relationship to Directors or Secretaries. The title of Mining Engineer is readily assumed; but there is reason to believe that some of the men who are now called Captains of mines, would not pass muster for miners of the first class in Australia. In such cases the Directors have exercised the patronage which has fallen into their hands in a more good-natured than judicious manner; and there may be in consequence a good deal of disappointment. But how are the Directors, who are not themselves to the manner born to mining, to know a first class miner, when they see him; or to detect the mediocre ability of a second or third class man? As time goes on, and their own false starts, and the blunders of the equally ignorant Directors of their Companies are brought home to them, they may learn a thing or two; but meanwhile the capital at their command will be dribbling away, and the public will become more clamorous for results. The shareholders will ask for dividends, and they will not be quieted by technical reports from the miners that are characterized by "much cry and little wool." There are, on the gold fields, some Mining Engineers, who may be safely trusted to go a-head economically, and conscientiously, without direction; but on the other hand, there are some engineers, so-called, who will need good deal of looking after, yet who may calculate with some safety upon the comparative freedom from direct control, which the five thousand miles between themselves and their Boards will give them. It is not necessary to assume that the latter class of men will not do their best, or will not act honestly by their employers; but their best may be far from satisfactory to those whose interests tkey are engaged to promote. This brings us round, then, to our former argument, that the Gold Mining Companies of India should be managed in India.

The Handbook contains the following list of Mining Engineers, and properties on which they reported favorably:—

Grove, W.	Central Wynaad.
Harris, Edwin	Grange
Harris, John	Kingston, Kaiser-i-Hind, Mysore Reefs, Nine Reefs, North Ooregum.
Harvey, C. J.	Cootacovil, Glenrock, Nilgiri, Tambracherry.
Lain, Thomas	Mammoth, Tambracherry.
Lindon, E. V.	Cherambadi, Madras.
Massey, J. D.	Parcherry.
Pogler, Oliver	Devalah Central, Devala-Moyar, Dingley Dell, Consolidated, Kingston, Needlerock, Wentworth, Wynaad Perseverance.

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Rogers, John	Nundydroog.
Simons, W. Vazie	Carta Para, Devala Provident, Dingley Dell, Simons Reef, South Wynaad, Wynaad, Wynaad District, Wynaad Glen, Ooregum, North Ooregum.
Smyth, R. Brough,	Devalah Centarl, Devalah-Moyar, Trevelyan, Rhodes Reef, South-East Wynaad.
Sowerby, W.	Central Wynaad.
Tapp, Henry	Cherambadi.

Of the above Companies one, the Indian Mammoth, is in liquidation. The Devalah Central, the Devala-Moyar, the Devalah Provident, the Indian Glenrock, the Indian Phœnix, the Indian Trevelyan, the Rhodes Reef, South-East Wynaad, the South Indian, the Tambracherry, the Wynaad Perseverence, the Colar, the Mysore, the Mysore Reefs, and the Ooregum Companies have obtained a settlement on the London Stock Exchange.—*Madras Mail.*

LIMESTONE AND GEMS IN THE RAKWANA DISTRICT: Mr. A. C. DIXON'S VISIT.

Dear Sir,—A paragraph in your valuable book on "Gold, Gems and Pearls," on p. 71, refers to the Rangwelletenne limestone and gem district around. It states what I could have seen, had circumstances been favourable. I beg to state that I *did* find limestone of similar quality to that analyzed by Mr. Hughes, but when I stated that the Rangwelletenne limestone was poor, I referred to the limestone *in general*, and not to *selected* boulders in particular. I got off at the girder bridge on the main road near the estate and went up the ravine. I found the *bed* which is referred to on native property, specimens from which I took as well as from boulders in the stream. Lastly, it states, that had my visit to the district been known, my attention would have been directed to the rich gemming district on Everton and Batakanda. These I also visited, taking note of the pits and collecting rough and cut gems as well as their associated minerals. I saw other districts not far away yet unworked, which, I have reason to believe, will prove richer than the Everton deposit.—Yours sincerely,

A. C. DIXON.

NEW INDUSTRIES: GOLD-PROSPECTING; THE MADRAS RULES.

The task of initiating new industries in any tropical or oriental land must inevitably be attended with much difficulty. There are necessarily no exact means of ascertaining what the returns will be for the money invested; and the new venture, whatever it may be, is regarded as a speculation more or less rash and uncertain according to the temperament and attitude of the critic. In a Colony like Ceylon with so many undeveloped resources, with a good supply of comparatively cheap labour, a favourable climate and easy means of trasport, every possible encouragement ought to be given to the pioneers in new industries. More particularly is this true in reference to the Government and gold-prospectors. The impetus that would be given to trade and to the development of local revenue, affords ample justification for the Crown, as the holder of immense reserves of land, setting its mining rights in abeyance altogether until the experimental stage had passed into one of settled and prosperous work. More than that it is the part of a Government situated like that of Ceylon to encourage prospecting and pioneering, by a system of well-considered "bounties." In several of the Australian Colonies this has been tried with success, and a bill is now before the Natal Legislature, with every prospect of being carried, proposing that the Natal Government should offer a premium "to anyone who, within three years from the 1st January 1882, shall introduce into the colony any new agricultural industry suitable and capable of general adoption in the

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colony by persons of moderate capital. The Council may make such regulations as they may deem fit for awarding the premium, provided that:—

a. No article at present exported shall be considered a new industry.

b. The claimant of the premium shall have grown, exported, and sold such product of a profit of not less than £1000 value during the three years.

c. The Council may, with the consent of the Governor, waive the necessity for the full value of the export within the three years, provided that the new product is of such a character as to attain to general cultivation, and fulfils the purpose intended.

d. Should two or more persons compete, and the product or products be such as to meet the general requirements of the reward, the Council may, with the consent of the Governor, apportion the whole or any part of the premium mentioned in Section 10 of this law in such manner as to them may seem fair and just.

The amount of premium proposed to be offered in this case is £1,000. The example is one that might be copied with great advantage in Ceylon; but we fear there is little chance at this time of the Government permitting the planting representative to widen the scope of his motion on Wednesday next. That motion has reference to "Mining Rights." It is extraordinary that the Ceylon authorities should have so long delayed to make their regulations known, seeing that the Madras rules, which they were supposed to be waiting for, were published some time ago. Our Madras contemporaries have criticized unfavourably the local Government rules, pointing out that they are far less liberal than those drawn up by the Mysore Government. The *Mail* advocates "free trade" in land for mining purposes, and supports its argument as follows:—

The Madras rules first limit the extent of land which may be granted, to one and the same applicant for mining, to 30 acres, in one block or more, though they allow land adjoining to be taken up for buildings, works, or what not, provided it is not used for mining. They next fix the assessment at the extremely high figure of R5 per acre on all land taken up whether for mining or other purposes. They then provide that within three months of the grant, not less than five coolies per acre of the land granted for mining shall be regularly employed. And they forbid any assessment or sub-lease, without the consent of the Government being previously obtained. It is probable that the Government wish to discourage land being taken up for speculative purposes, and to prevent large areas getting into hands of the same individuals. If, as in the early days of gold in Australia, men took up small pieces of land, and worked them themselves, washing the soil for gold, and using only the simple appliances each individual miner could command, and if there were any chance of all the available land being so taken up, we could understand the policy of limiting the area of mining grants—only we should then say, the limitation did not go far enough, and that instead of 30 acres being granted, the grant to each should not exceed a few square yards. But there is no chance of anything of this sort in India; the climate is against it; everything is different. We are beginning where they only arrived in Australia after years of work—with quartz-crushing on a large scale, which demands the best machinery, and a capital so considerable that it is almost a necessity that the mines should all be worked by Companies which, now that everything comes out in £1 shares, will probably have their thousands of members. Now Companies, as a rule, want a good deal more than 30 acres, and if each shareholder had 30 acres it would have to reckon the extent of its property by square miles. Though only 30 acres may be given to the same applicant, there is nothing, so far as we can see, to prevent ten men going in for ten adjoining 30 acres lots, and making them over to a Company in one lot of 300 acres, except the rule prohibiting transfers without the consent of the Government, which we think, could never be enforced, and would be

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practically a dead letter. So again a man might apply for ten 3 acres lots, with say 27 acres of land for other purposes adjoining, and when he had sold one of these lots, the purchaser could, at once apply for a mining grant for other 27 acres, taking up the land for other purposes alongside. In fact whether the rule is wise or not, it is certain to be evaded. But we deny its wisdom altogether. We consider such speculatton as it is (presumably) intended to prevent perfectly legitmate; and we look on it as only right and just that a man, who by superior skill, energy, or even luck, finds himself in the position of the discoverer of a valuable formation, in what was supposed to be valueless land, should be able substantially to profit by the position. Suppose that one of the pioneers after the expenditure of much time and trouble, and no inconsiderable outlay of money, finds a few square miles of auriferous lands; it is extremely hard that he shall only be able to get 30 acres of it, and that all the rest shall be given to Tom, Dick, or Harry, who never spent a rupee in the search, or gave a single thought to the subject.

Then again, take the assessment. The land wanted for mining will be waste; and not waste only, but in nine cases out of ten, unculturable, or practically of no value whatever for any purpose except mining. Land as good, or better, can be had for cultivation at rates varying from As. 4 to R1 an acre; why then this heavy assessment which is about the same as that imposed on the best class of irrigated land. It may be said that with a paying mine, the assessment will be a trivial item, and will hardly be felt. This we grant. We go further and say, that with such a mine, an assessment of R5 an acre will, by no means, represent the share of profit which the State may fairly expect to derive from the venture. But gold mining is at present in its infancy in India, and it is pretty certain, that some of the mines will come to grief, though others may pay handsomely. Take the case of a non-paying mine, with 30 acres of mining land, and adjoining land taken up alongside to the extent of 1,000 acres—of course with the object of eventually applying for further mining grants if the concern is a success. This land will be burdened from the start with a yearly payment of R5,150, and may never make a rupee of profits! Surely it is unwise to handicap enterprize so heavily! It is not as if Government were giving up land, from which revenue could be drawn in any other way; for as we have already pointed out, if not, taken up for mining it will never pay a rupee to the State in the great majority of cases. Again, suppose this Company is making a profit of £100,000 a year, would the payment of R5,150 be absurdly inadequate. Why then should not land be given on a very light assessment, say As. 4 or As. 8 per acre and royalty of, say 5 per cent. charged on the nett profits? Then while the prosperous Company would be a source of considerable revenue to the State, the struggling and unsuccessful one would not be unduly burdened. A royalty on nett profits would always be cheerfully paid, for the larger the payment to Government, the larger would be the profits to shareholders, and under such a rule as this, there would be a fair chance that all land giving promise of good results, would be taken up, and tried.

But bad as all this is the labour clause is undoubtedly worse. Not less than five coolies per acre are to be regularly employed, that is one hundred and fifty coolies on 30 acres—representing probably an expenditure of R800 a month. It may be taken as tolerably certain, that if it pays to employ five coolies per acre, or double, treble, or ten times that number, they will be employed, and if it does not pay, we fail to see why their employment should be insisted on. And the beauty of it is, that Government gain nothing by it. Had there been a royalty instead of a fixed assessment, we could have understood the condition, though we should still have considered it unwise: but as things are, Government get precisely the same amount, whether the mine is being worked at a loss, or is giving a magnificent return. Again the cooly test is a somewhat rough and unscientific one. If it is desired to insure a certain

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expenditure,—which, however, we deprecate altogether—it would be better to say that so much a month shall be spent on mining operations. Most of the work is done by machinery; mining engineers and skilled English miners are found necessary; none of this is taken into account; the hard and fast coolie labor test holds good, and is brought into force three months after the grant is made—long before a Company could be got into working order, and put the necessary machinery and staff on the ground. This one clause alone is enough to condemn any rules of which it forms a part.

We trust the blunders pointed out so clearly in the Madras rules, and which it seems are not to be found in those operating in Mysore, will be avoided by the Ceylon Government. To help them to a right conclusion we append a list of rules for granting out mining land, drawn up by the *Mail* as embodying all that is required in the case of Southern India, and therefore well applicable to the case of Ceylon:—

Persons desirous of obtaining permission to mine, on Government waste lands, may apply to the Commissioner, or Collector for leases specifying the situation of the land required with its estimated area. Each application shall be accompanied by a rough sketch, or by the survey map with the position of the block roughly indicated.

Applications will be dealt with in order of receipt. No lot or lots in one application shall exceed one square mile in extent.

But the same applicant may apply for more than one square mile in other applications, and such applications will be granted should there be no reason against it.

On an application being accepted the lot shall be durably demarcated, and conveyed at the expense of the applicant, to whom a lease shall be granted.

An assessment of As. 8 per acre shall be payable by two half yearly installments on 1st January and 1st July, the first installment being due for the then current half year, and payable on the date of the execution of the lease.

The land may be thrown up at any time, but so long as the assessment is paid, and the conditions are not broken, Government will not resume or interfere with it.

The land shall be liable to road assessment.

A Royalty of 5 per cent. on the nett profit of any mining operations shall be payable to Government. The works shall at all times be open for inspection by the Commissioner, or Collector, or by officers deputed for the purpose by him.

Accounts shall be furnished to the Commissioner or Collector yearly, and books shall be duly kept, which shall at all reasonable times be open to the inspection of the Commissioner or Collector, or officers deputed by him.

GEM AND GOLD MINING RIGHTS IN CEYLON.

General Rules promulgated December 1891.

1.—The Government will claim no royalty on or share of the gems or gold found upon land in respect of which a license has been taken out, and is in force under these rules, but such land will be liable to any taxation which may hereafter be found necessary to provide, at the expense of the grantees, the cost of such special police communication, water supply, sanitation or other similar administrative arrangements as may, in the opinion of Government, be dictated in the interests of the local community immediately or directly affected by the results of the grantee's operations.

2.—No license granted under these rules will convey any right to fell or destroy timber.

3.—No license granted under these rules will convey any right todi ver any water course.

4.—Licensees who desire to divert any water course must first obtain special permission in writing from the Government Agent of the province for that purpose. Such special permission must limit the diversion of the water course to the area covered by the permission to dig, and must stipulate that all water running waste shall be returned within the limits of such area to its natural channel.

5.—The Government reserves to itself the power to alter, cancel, or add o any of the preceding or subsequent rules.

Particular Rules: Prospecting Licenses.

6.—Prospecting licenses will be issued only for *Crown Waste Lands.*

7.—No prospecting licenses whatsoever will be issued to dig for *gems.*

8.—Prospecting licenses will be issued to dig for *gold* on payment of R10 and on the following conditions:—

The area on which the license is to extend shall not exceed half a square mile.

The license shall be in force for six months.

The grantee to have the exclusive right of prospecting within that area for that period and to have the option, at the expiration thereof, of applying for a regular lease of not more than 50 acres within the said area on the terms hereinafter described.

Gemming Lands alienating by the Crown.

9.—The proprietors of lands on which the rights of the Crown to gems have been reserved may obtain a license to dig for and appropriate such gems on the paymennt of R10 which license will be in force for one year, and may be renewed annually on the like payment.

Mining.

10.—The proprietors of private lands may obtain a license to dig for *gold* on their lands on the payment of R10, which license shall be in force till the then next ensuing 31st December, and may be renewed annually on a like payment.

Crown Waste Lands.

11.—Unlicensed diggers for *gems* on such lands will be prosecuted.

12.—Personal licenses will be issued to dig for gems on such lands on the following conditions:—area not to exceed two acres: period till the then next ensuing 31st December. Price to be R5.

13.—Mining leases will be issued to dig for gold on such lands on the following conditions:—

Area to be determined by Government as occasion arises, but no lot is to exceed 50 acres, nor will more than 50 acres in all in one or more blocks be leased to one applicant. The minimum breadth of any lot to be 70 yards.

Period.—A term not exceeding 20 years, at expiration of which the lease shall be renewable at the lessee's option on such terms as the then Governor and Executive Council may fix.

Price.—Prepayment by the applicant of survey fees and an annual rent of R5 for each acre or portion of an acre payable in advance by two half-yearly instalments on 1st January and 1st July in each year, the first payment to be made on the date of the execution of the lease for the then current half-year and payment thereafter to be made on or before the first day of the next calendar half-year.

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General.—Government will reserve the right to resume and enter upon possession of any part of such land as may be deemed necessary for the construction of railroads, roads, bridges, or canals for public purposes, or for the benefit of the proprietors of other lands purchased from the Crown, and also the right for persons, acting under Government, to search, dig for, and take away indigenous timber, stones, cabook and other materials, the produce of such lands necessary or requisite for the making and keeping of the said roads and bridges and canals in repair or for any other public works whatsoever. The lease to become forfeited by non-payment of rent with power thereupon to Government to re-enter upon the land summarily without process of law and to remove all plant, buildings, &c., which may be thereon and lease or sell the land to others.

Departmental Rules.

14.—Application for permission under the preceding rules should in the first instance be addressed to the Revenue Officer of the district in which the land is situated and should specify distinctly the situation of the land within which it is proposed to dig; its boundaries as accurately as can be stated and its estimated area. Every application should be accompanied by a rough sketch of the tract applied for.

15.—Applications will be dealt with in the order in which they are received.

16.—Immediately on receiving the application the Revenue Officer will ascertain whether the land is at the disposal of Government and whether there is any objection to the grant, by reason of the land being required for public purposes, for sale, or agriculture, for timber or other reserves, for preservation of irrigating water courses, or on any other ground.

17.—The Revenue Officer shall report these matters to the Government Agent who shall thereupon determine in each case whether permission should be granted, and if so upon what conditions.

18.—The Government Agent must refer for final decision of Government all applications for mining leases, and must in such cases procure the necessary survey of the property and forward it to Government, with a draft lease which will be executed in triplicate, one copy for the grantee, one to be on record in the Government Agent's Office, and one in Colombo.

19.—Application for licenses will be dealt with by the Government Agent without reference to Government, except in case where he requires instructions.

20.—Registers of applications for mining leases and for licenses will be kept in the Government Agent's Office in forms prescribed by Government.

PEACOCK COPPER ORE IN CEYLON.

We call special attention to the discovery of this valuable ore in the Hewaheta district. In reply to our enquiry the other day Mr. Walters writes:—

Gonavy, December 19th, 1881.

Sir,—I notice the remarks in your Friday's issue (*Ceylon Observer*) respecting a specimen of ore sent you some time since, which Mr. Dixon then pronounced to be iron pyrites. Probably had I mentioned, when sending it, that it had been tested with a strong acid, the peculiar colouring it had assumed would have attracted more particular attention. I now send you a piece of the ore freshly broken off. Will you kindly allow him to compare it with the specimen previously sent. This ore was found in Hewaheta.—Yours faithfully,

W. H. WALTERS.

This letter recalls to our distinct recollection the fact that Mr. Walters sent us some months ago the specimen which at first was pronounced to be iron pyrites and again a manganese ore, but which, on being tested, Mr. Dixon found

to contain 20 per cent. of copper. But, if there had been any doubt, this second sample sent by Mr. Walters would remove it, for it is a beautiful little specimen of peacock copper ore. Hewaheta is evidently going to take the lead as a mining district. It is from Great Valley estate here that the quartz has come which Mr. Harvey declared should yield 4 or 5 dwts. of gold to the ton, being identical with the quartz from one of the best of the South Indian mines. This quartz is very "dirty," almost dark brown in appearance, and might almost be taken for a copper-yielding ore. Mr. Hart of Great Valley has been most energetic in his prospecting, going down seventy feet into his reefs, and he well deserves success. He sends us some separate samples of quartz and of the clay and schistose deposits surrounding the reef which seem very promising. Meantime, to return to the copper ore, we feel sure that Messrs. Sabonadiere & Co., agents for Gonavy, will not loose time in looking after what may prove more valuable than the best auriferous quartz in the country. One who has evidently had practical experience of copper ores and mines writes to us as follows:—

Dear Sir,—Your paragraph about Peacock copper ore I think certainly deserves larger letters than you have given it. If the ore mentioned by Mr. Dixon was found here, it is I should say the most valuable find that has yet been made, and no pains should be spared to discover its whereabouts. Peacock ore is usually found in pockets in large deposits of less rich but still very valuable copper pyrites: its presence would therefore lead one to expect the existence of a larger deposit, in the same locality. I have often looked for copper ore in Ceylon (but without success). The formation appearing in many parts similar to that of the immense deposits of Santo Domingo in Portugal and the Mina del Tarsis in Huelva, Spain. A simple way of distinguishing copper from iron pyrites is that copper pyrites can be scratched or cut with a penknife, while iron pyrites cannot, and the softer the pyrites the richer it is in copper. 7 to 10 per cent. is a paying ore in S Europe, and I dare say would pay here also. Iron pyrites is usually valueless.

R. I. P.

We had heard that under favourable circumstances, such as cheap labour and transport, three per cent. of copper in the ore would prove profitable; but, even if seven to ten per cent. be required, Mr. Dixon's twenty allows a handsome margin. The "peacock" ore, as our correspondent points out, is generally found in pockets in the reef:—here a rich pocket, then a faint streak of the copper ore running through the reef to the next pocket, and so on. Mr. Dixon does not think it at all improbable that the Gonavy reef may run through Maturata and crop up even in Udapussellawa, where, it is said, a quartz with indications of copper and sulphur has already been obtained. A careful examination is called for, and as Mr. Dixon leaves for the Pussellawa and Ramboda districts on Monday next, we trust he may find time, before his return, to visit the other side of the Pedro range and give his opinion on the course of the reef. Individual proprietors will, of course, be anxious to get an opinion on their prospects, and they cannot do better than communicate with the "Geologist."

GEM-DIGGING IN BAMBARABOTUWA, CEYLON.

(From an Old Colonist.)

About the beginning of last year gem-digging was commenced on a large scale in Bambarabotuwa. The first spot that seems to have attracted attention was Kekunagahadola, on the lower end of the Petigalkanda range, as it joins the Bambarabotuwa hills, about 12 miles west of Balangoda. There is a hardly practicable foot-path to the spot from Pelmadulla. Early in 1881 several large "catseyes" were found here, and during the middle of the year there were, it is said, over a thousand men hard at work in the gem-pits, about Kekunagahadola and Lilwalahena, about half a mile to the

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south. About this time a large number of diggers established themselves on the private property in the forests of Hapugastenna and Kundragalla, where they found rubies and sapphires. The pits they sank are about 12 feet deep and 15 square. To the depth of about 4 feet the usual reddish yellow soil is found, discolored towards the surface by vegetable matter; below this there is a stratum of from a foot to eighteen inches thick, of gravel-sand and well-rolled pebbles, in all respects similar to the bed of a stream.

It is in this stratum that the gems are found. In some of the pits, tunnels have been formed for many yards, which must be very dangerous, as no attempts are made to shore up the earth. Some months ago the Assistant Government Agent of Ratnapura brought a certain number of diggers before the District Court, and it is said that the District Judge fined them R10 each. They appealed to the Supreme Court, and the judgment of the District Court was quashed, the fines being refunded to the diggers, who immediately renewed their operations on the Crown lands in the forests about Kekunagahadola, where there are at present several hundreds at work.

The Massana estate is at the upper end of the forest to the east of Kekunagahadola and Lilwalahena, and a small piece of land on the property has been rented to the diggers at the rate of R50 a month. Here also catseyes would appear to be the principal gems found. When poor Crüwell was in charge of this estate, the late Dr. Rudolf Gygax went with him and some other friends in search of precious stones, and though they found nothing of much value, poor Gygax considered that a properly organized search on scientific principles would be likely to prove highly remunerative, but we were all so sure of making fortunes then with coffee, that no one liked the idea of allowing anything to take his attention off the one absorbing pursuit. Amongst the rumours in Boltumbe and Bambarabotuwa, it is said, that a Moorman with two Kandyans from Balangoda, went into the Wellawaya forest, up the bed of the Welawe stream, and in two days returned with a catseye, for which they were offered R1,000 in Balangoda. The roads opened about thirty years ago in Bambarabotuwa and Boltumbe, are in many places almost obliterated. They were traced by Government, and sections were made of them, and they were formed into very superior bridle-paths by the planters. Such portions of them as are used by the villagers are still almost fit for cart traffic; in some places they have been blocked up for chena cultivation, and the approaches to the chenas cut through, so that the trace is difficult to find. The Road Committees seem to ignore the line altogether, although few parts of the island are in such great need of being opened up by roads.

If there were any well-defined law on the subject of gem-digging, it is more than probable that capital would be forthcoming for the due prosecution of the search for precious stones, and that an important business would spring up, and bring wealth and civilization into what is now the wildest and most savage part of Ceylon. But in the present uncertainty as to the claims of the Government, and the apparent absence of all law on the subject, no one who has anything to lose can engage in such a speclation. The consequence is that the persons now occupied in gem-digging are more like banditti than laborers, and lead a very lawless and reckless sort of existence. There certainly can be no reason for leaving the precious stones hidden in the bowels of the earth where they have been for countless ages, but the present state of all matters connected therewith cannot be considered creditable to a community under European control.

It is not in this way that the Europeans at the head of affairs in Borneo manage the gold washing, at Sambos, Pontianak and Banjirmassing; and unless the Bambarabotuwa gem-diggers are looked after, we may look out for something startling one of these fine mornings.

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[In a private note to a friend, the writer adds:—"We had to clear our way along our old bridle-path from Boltumbe and in doing this came on several snakes. I send you one whole, which the natives, as usual, say is deadly; * it certainly looks a dangerous beast to me, and the head of a big reptile that could not be got into the bottle. † The snake the head belonged to was basking in the sunshine on a rock in the middle of the path. I have made drawings of the gem diggers, huts, and of the hills where hundreds of gem diggers are now in active operation. Could you put me in the way of sending them to one of the illustrated papers? I think they are the kind of things that such papers would reproduce. I send with this a short account of what I saw and heard during my trip. We did not find any people at work on our land, but we put up in a very good hut they had built, and saw plenty more huts and no end of gem-pits." We shall be glad to forward the sketches and the above description to the editor of the *Graphic*, who, we doubt not, will be very ready to make use of them.—ED.]

SPECIMENS OF GOLD-BEARING QUARTZ FROM VICTORIA AND THE GOLD PROSPECTS IN CEYLON.

Apart from the fact that prospecting for gold is going on in our island the Ceylon Commissioner to the Melbourne Exhibition would have considered it part of his duty to have obtained for the colony he represented representative specimens of gold-bearing quartz and pyrites. As mere geological and mineralogical illustrations, as indications of the prevailing characters and constituents of gold-bearing strata, the collection would be interesting to scientific men. But the possibility of a paying gold-field occurring in Ceylon adds a fresh interest to the contents of the little box, which the Commissioner owed to the courtesy of Mr. Barnard, F. G. S., Registrar of the Ballarat School of Mines, a most valuable institution, where, for very moderate fees, pupils, including working miners, are taught the whole circle of the sciences, ranging from Mathematics, Drawing and Surveying, Geology and Botany, Magnetism and Telegraphy (female pupils taught) down to Chemistry, Engine-driving, and under-ground mining. As the latter pursuit involves constant liability to accident, the pupils who are qualifying themselves for taking charge of shafts and mines receive a thorough and practical training, not only in Materia Medica and Physiology, but in the treatment of wounds and fractures. We are not likely to forget our night visit to the School at Ballarat, when the enthusiastic surgical lecturer, Dr. Ussher, imprisoned us in his class-room until we had seen a tall, strong young fellow bound and bandaged and pinioned, so that he resembled a mummy! No language of ours can be too strong to express the sense we feel of the advantages enjoyed by the youth of Victoria, in being able, after common school age (15) to receive at slight expense a very high scientific and practical training at either the Mining School at Ballarat or the sister institution at Sandhurst. The life and soul of the latter is Mr. Alex. Bayne, to whom, as to Mr. Barnard, and also Mr. Cosmo Newberry of the Melbourne Technological Museum, the Ceylon

* This is one of the pit vipers, the kunakatuwa and polon-telissa of the Sinhalese, the *Hypnale nepa*, an oily-looking, flat-headed, marbled snake, very common from the coast up to 6,000 feet elevation. It has been erroneously figured in Davy's History of Ceylon as the "karawala," which is the *Bungarus Ceylonensis*.

† The head indicates its close affinity to *Aspidura Copii*, so rare in 1864, when Günther's work on the Reptiles of British India was published, that only one specimen was known, and this was conjectured to be from Ceylon. It has since been found in Dikoya, and one specimen exists in the Colombo Museum. The head sent proves that it is an aberrant form or new species of Aspidura. Could our friend try and secure an entire specimen of this snake?—W. F.

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Commissioner was indebted for great courtesy and much information of a very valuable kind. We heard and discussed many theories, as probable solutions of the questions we were ever asking, "How came the gold to form in the rocks and especially how came the particles to aggregate?" Our inclination is to believe that gold, like quartz, was deposited from water, but that goes but a small way to clear up the mystery. Before handing over the collection of auriferous quartz from the Ballarat Museum to Mr. Bruce, to be by him placed at the disposal of Government, we sought and obtained permission to place the box at the disposal of our local geologist and mineralogist, Mr. Alex. Dixon, for inspection and report, the report to be published in the *Observer*. We at the same time sent Mr. Dixon our private collection of specimens of rocks, metals and roasted and crushed pyrites. On the latter Mr. Dixon will have something to say in due time. His report on the collection intended for Government, and which collection we think it probable Government will place in the Economic Museum, we now append:—

NOTES ON AURIFEROUS QUARTZ SPECIMENS FROM BALLARAT.

This is a representative collection of quartz, more or less auriferous, presented by the Ballarat School of Mines to the representative of the Ceylon Court. These specimens show the mode of occurrence of gold and its associated minerals from the district around Ballarat. They are well worthy the attention of all interested in gold in Ceylon. Ballarat is situated in the colony of Victoria, one of the richest gold-producing districts of Australia. The geological formation is chiefly metamorphic schist or slates of silurian age.

Our Ceylon rocks are metamorphic, in several parts chistose and no doubt of Palæozoic age.

In Victoria gold was first obtained from alluvium and then followed its extraction from the quartz rock. From this colony from 1851-65, no less than 30,422,591, oz. were exported to the value of £121,690,363. This passed through the Custom house, and it has been estimated that nearly 4,000,000 oz. were sent away otherwise.

From 1868-78 the gold extracted from alluvium was over 6 million ounces, while that from quartz was over 6¼ million oz. There has been a steady decrease from the alluvial deposits; and from the quartz, the amount has not increased since 1877.

One nugget found at Ballarat weighed 184 lb. and was valued at £8,376 10s. 6d.

SPECIMENS.

No. 1, 2, 3.—This is a milky white quartz veined over with mispickel (arseno-pyrites). Free gold is visible as granules and as plates amongst mispickel. This quartz contains 7 oz. to the ton. The reef is in metamorphic schist 200 feet from the surface and 1,400 feet above the sea level. Locality, Owen's river. In No 2, the gold is more distinctly visible than in No. 1, and in 2 and 3 it is visible but sparingly.

[Mispickel (arsenical-iron-pyrites) is of a tin or silver white colour including to steel grey, crystallizing in rhombic prisms. Its composition is bisulphide and arsenide of iron. Generally from 30 to 36 % iron; 41 to 45 % arsenic and 18 to 21 % sulphur.]

No. 4.—This is a milly white quartz very compact and less veined with mispickel than the preceding. Gold is distinctly visible. The yield of this is 1 oz. to the ton and the reef occurs in metamorphic schist. Depth 1,120 feet at 293 feet below sea level. Locality, Stawell.

No. 5.—Dirty white quartz of great specific gravity, full of iron pyrites which crystallizes in cubic form and faces often striated and of a pale brass-yellow color. Note the difference between this pyrite and the former mispickel. No gold is visible. It yields 15 dwt. to the ton taken from a depth of 300 feet at an elevaion of 1,600 feet above sea level. Locality, Gordon.

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No. 6.—A quartz of very loose texture, somewhat resembling a breccia of a reddish colour, due to iron. It is highly ferruginous with most brilliant irridescent hues, due to the films of iron oxide. One or two specks of gold are visible with a magnifying glass. It has a felspathic external surface. It yields 10 dwt. to the ton. Depth 250 feet; above sea-level 1,140 ft; locality, Sebastopol, Ballarat.

No. 7.—A dense flaky quartz, somewhat ferruginous with a considerable quantity of metal, viz., argentiferous galena and auriferous pyrites. Note the peculiar shade of pyrite differing from the brassy iron one. This specimen was taken from a depth of 60 feet at 90 ft. above sea-level. Locality, St. Arnand.

[Galena crystallizes in the cubic form with a perfect cleavage. Its color is a lead grey with metallic lustre. Composition is sulphide of lead and a little sulphide of silver. If the silver is in sufficient quantity to be worth extracting it is termed argentiferous.]

No. 8.—A dirty white quartz, compact in texture, full of cavities with crystalline quartz. A little mispickel occurs. No gold is visible to the naked eye but slight specks show with the aid of a magnifying glass. Yield 6 oz. to the ton. Depth 240 ft.; above sea-level 1080; locality, Ballarat.

No. 9.—A whitish-looking quartz, somewhat glassy, with auriferous pyrites, a few specks of mispickel occur. Gold is not visible. Yield 18 dwt. to the ton and was taken from a depth of 1,200 feet at 300 ft. above sea-level. Locality, Clunes.

No. 10.—A white quartz stained reddish by iron. A little chlorite is present. It has a curious mammilated quartz surface on one side with an iron casing below. There is a peculiar tinge of iron which is very common in Ceylon quartz. Gold is distinctly visible. Depth 60 ft. at 2,080 above sea-level. Locality, Daylesford.

No. 11.—Quartz of a milky white character with a slate-wall. Gold is distinctly visible on this slaty-wall along with a little auriferous pyrite. Depth 600 ft. at 1,200 ft. above sea-level. Locality, Blackwood.

No. 12.—Dirty white quartz with a beautiful mass of rock crystal, the crystals being a double hexagonal pyramid. A little arseno-pyrite is present but gold is not distinctly visible. Depth 300 feet at 1,150 above sea-level. Locality, Ballarat.

Nos. 13 and 14.—Beautiful, white, milky quartz with auriferous pyrites, blende and galena. Free gold is very distinctly visible in both specimens along with the blende. (14 is a very rich specimen.) Depth 450 feet at 400 above sea-level. Locality, Maldon.

[Blende or black jack crystallizes mostly in dodecahedrons; it is usually black or brown. Composition is sulphide of zinc.]

No. 15.—A whitish quartz much stained with iron, causing it to look reddish. Gold is distinct visible on the iron ore studded all over its weathered face. Depth 80 feet at 1,400 above sea level.—Locality, Ballarat.

No. 16.—A bluish glassy quartz; very cavernous. Gold is distinctly visible in the caverns and on other parts. Depth 900 feet at 60 below sea-level. Locality, Stawell.

Chief points noticeable in collection:—

1. The great density of the quartz.
2. The compactness of the quartz except in 6 and 7 which show that compactness is not a necessary characteristic.
3. The general association with other metals.
4. The colour of quartz is nil in determining gold. If need not look warm, as has often been stated, for 11, 12 and 13, as far as general appearance goes are cold and decidedly hungry, destitute of caverns and destitute of other minerals. White is the prevalent color in this collection, stained variously with iron.

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5. The quartz being in crystalline condition is not a sign of its containing no gold. See No. 12.

6. The visibility of gold is worth nil for Nos. 1, 5 and 8, are rich in gold. It has recently been stated that assayers are of no use. We are told we must be able to see and judge by the eye as to whether a quartz reef will pay and that it is a poor tale to have it tested. However such statements are not worth much. If we see the gold and know that it extends in the quartz, we then know without assay that it will pay and its extraction may be at once begun with.

Assaying of fair samples is very necessary. There is not sufficient sight-evidence in many varieties of quartz to warrant gold being there in paying quantity. Even the rough amalgamation process, so commonly used by the miner is unreliable where the gold occurs with pyrites. Nor can the amalgamation process be successfully used for its extraction in such cases, *e. g.*, three samples of auriferous pyrites were operated upon not long ago.

(*a*) From Siberia which contained 100 grams to the ton.
(*b*) „ Venezuela „ 300 „
(*c*) „ California „ 150 „

The first yielded all its gold by amalgamation. The two others, both in the raw state and after roasting, yielded only insignificant quantities. From further experiment, it was inferred that the presence of antimony and arsenic prevent amalgamation.

The tailings of old mines are now being re-worked by the "Chlorine process" or by the still better method devised by Mr. W. A. Dixon. See "Directions for extracting gold, silver, and other metals from pyrites." *Proceedings of the Royal Society*, vol. 20.

Ceylon quartz is rather *too glossy* in appearance and from many localities is *destitute of metal* of any kind, or having caverns either empty or filled with earthy matter. The pyrites are of too brassy a nature. However, we have quartz partaking of the character of Nos. 6 and 16 in Hewaheta and Ramboda. A somewhat similar quartz to 10 and 15 occurs in Balangoda and the district around.

In the Nawalapitiya district, we have a quartz partaking of the nature of 11, 12, 13, but no metal is visible. The mineral galena, mispickel and blende have not been recorded up to the present time as occurring in this island.

Mr. Dixon, we know, has judged rightly in stating that the mere colour of quartz is no certain criterion of its value. We took with us to Melbourne a specimen of gold-bearing quartz from the Alpha Mine in Southern India, and, judging by what we had seen in Devalah, we expected to find the specimens of Australian gold-bearing quartz sent to the Melbourne Exhibition full of pyrites and rusty coloured. Some such quartz we did find exhibited, but the leading specimens (some of them immense blocks) were pure white, shading away to grey). A person acquainted with only the surface quartz of Devalah would certainly never have suspected the existence of gold in pure white and occasionally crystalline quartz. The uneducated eye, therefore, is here at fault, but the merest tyro soon learns the value of "Black Jack," or blende as an indication of the presence of gold, equally with mundic (iron or arsenical pyrites) and galena. Blende, Mr. Dixon explains, is a sulphide of zinc, while galena is composed mainly of sulphide of lead; sometimes rich in sulphide of silver. We suspect that neither "black Jack" nor galena exist in Ceylon, any more than the special "Lower Silurian" slate formations so strongly insisted on in Victoria. But "mispickel," which Mr. Dixon describes as arsenical iron pyrites, ought surely to exist. The first great revolution in the search for gold was the discovery that hundreds and even thousands of feet below the alluvials of Mount Alexander, Bendigo, Ballarat, Arrarat, and other once rich but entirely or partially exhausted gold fields, and underlying enormous masses of the basaltic rock known locally as "blue stone," vast stores of the precious metal lay hidden. It is found either *in situ* in the old quartz and slate formations, or

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washed into the channels of ancient rivers, sent underground, "where Alph, the sacred river, ran," by volcanic convulsions. Gold has been certainly found down to 2,000 feet, and, as a shaft at Stawell has penetrated to 3,000 feet and will probably go deeper, it is impossible yet to fix the lowest limit of underground finds. What with powerful rock borers and especially by means of the wonderful diamond drills capable of piercing at all angles, while cores are taken up and examined at every few feet of progress, shaft-sinking and gold mining generally is fast passing from a precarious lottery to a steadily profitable pursuit. The value and probable effect of the diamond drills cannot possibly be exaggerated. The next great revolution was the discovery that pyrites, which had been rejected as worthless, could, to a large extent, be utilized with great profit. Accordingly every important gold mine has now appliances for roasting and crushing pyrites. Through the courtesy of Mr. Thompson, the able manager of the Walhalla mine in Gippsland, probably the richest gold mine in the world, we were able to bring, amongst other specimens, a sample of pounded pyrites ready for the amalgamating process. On this Mr. Dixon will, doubtless, have something to say. The difficulty of dealing with pyrites is the large quantity of deadly fumes of arsenic evolved in the process of roasting. Tall chimneys, to carry those fumes for dispersal in the higher atmosphere, must be erected under heavy penalties, and the effect of the fumes on vegetation were very apparent on the side of a steep mountain, close to which rose the chimney of the great mine at Walhalla. Trees and grasses, within the influence of the fumes from the flue, were withered or dead. The Walhalla Valley, rich not in alluvial gold but in gold-bearing rocks, differs essentially from the valleys between or at the foot of low, rounded, water-worn hills at Castlemaine, Sandhurst, Ballarat and other places, where scores of miles of alluvial soil have been torn and turned over after a fashion which excites the astonishment of the traveller. We could not help asking if any approximate estimate had ever been attempted of the number of cubic feet of earthwork involved in all the digging and re-digging by Europeans, and the re-re-digging by Chinese over the gold fields of Victoria. Our friends only looked aghast at the idea of so utterly hopeless an attempt. Our own belief is that a girdle of railway round the globe would not be more than the equivalent. Next to the skeletons of a burnt forest in Australia, the most awfully desolate of scenes, is made up of the grave-like mounds scattered as thickly as leaves of Vallombrosa over a deserted gold-field. As the mountains stood round about Jerusalem, so do they stand round the gold valley of Walhalla—real mountains and not water-worn hills such as are seen near the alluvial gold fields which first made Victoria famous. From first to last 50 millions of ounces of gold have been taken out of the soil, worth 200 millions sterling. No wonder if at Ballarat and Sandhurst great towns arose, and a vast city on the shores of Hobson's Bay, with the rapidity which is more a characteristic of dream and romance than of real life. Mr. Dixon notices that one nugget was found at Ballarat, which weighed 184 lb., and for which over £8,005 were paid. We do not know if he refers to "the Welcome Stranger," found (at Dunolly, however) by two Cornish miners, just when one of them had been refused credit for a bag of flour and feared starvation for his family. The scene was soon changed, as will be seen by the following details taken from Sutherland's "Tales of the Gold Fields":—

"Deeson plied his pick in some hard bricklike clay around the roots of an old tree, breaking up fresh earth and tearing away the grass from the surface of the ground. He aimed a blow at a clear space between two branches of ihe root; and the pick, instead of sinking into the ground, rebounded, as if tt had struck upon quartz or granite. 'Confound it!' he exclaimed 'I've broken my pick. I wish I had broken it, if it had only been over some nugget.' A minute afterwards he called out to Oates, and told him to 'come and see what this was.' It was a mass of gold cropping several inches out of the ground like a boulder on a hill. As each successive portion of the nugget was

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disclosed to view, the men were lost in amazement at its enormous size. It was over a foot in length, and nearly the same in breadth. The weight was so great that it was difficult for the two men to move it. However, by dint of great exertion, they succeeded in carrying it down the hill to Deeson's cottage, where they commenced to inspect their wonderful treasure. It was so completely covered with black earth, and so tarnished in colour, that an inexperienced person might have supposed it to be merely a mass of auriferous earth or stone. But its weight at once dispelled all doubt on that point, for it was more than twice as heavy as a piece of iron of the same size.

"Great was the rejoicing among Deeson's family. The wife piled up a huge fire, and Deeson placed the nugget on the top, while the rest of the family stood around watching the operation of reducing the mass to the semblance of gold. All through the Friday night Deeson sat up before the fire, burning the quartz which adhered to the nugget, and picking off all the dirt and débris. This was so rich that, on being washed in the puddling machine, it yielded ten pounds' weight of gold. Meanwhile Oates had procured a dray to convey the nugget to town, and on the Saturday morning the two men set off for Dunolly. It was a ten-mile walk; but many of the neighbours, having heard the news followed the dray into the township. * *

"They stopped the dray at the door of the London Chartered Bank, while the crowd grew larger and larger.

"Deeson now stepped into the Bank, and, having requested see the manager, he proceeded to open negotiations with him by asking, 'How much do you think you would give for a lump of gold as big as your head?' The manager, thinking the digger was drunk, ordered him away, and requested his clerk to see him to the door. But catching sight of the crowd outside, he stepped out and looked into the cart. The tone of the negotiation was altered at once, and the two diggers were politely requested to enter.

"When the nugget had been deposited on the floor of the banker's room, it was weighed, and the amount of pure gold was ascertained to be 2,268¼ ounces, or nearly two hundredweights. Thus, being nearly 100 ounces heavier than the Welcome nugget of Ballarat, it was probably the largest piece of native gold ever found. Various accounts have been given of a still larger nugget having been discovered in Brazil over a hundred years ago. But this story rests on no good foundation, and even if it is based on fact, it has evidently been exaggerated. All the best authorities on the subject, therefore, set down the Welcome Stranger as the largest mass of gold ever discovered."

We doubt if any such mass of gold exists in the soil of Ceylon, if indeed "payable quartz" for stamping exists. No better aids to the solution of this question can possibly exist than the specimens from Ballarat with Mr. Dixon's notes on them.

We have, on this occasion, merely glanced at a few salient points on the characteristics and history of a substance and a pursuit, round which cluster more of romance and vicissitude than is connected with any other material substance or human enterprize. The subject is practically inexhaustible, and we hope to return to it in future issues.

Since writing so far we have seen a letter addressed to the *Australasian* on "GOLD AND WHERE TO FIND IT," by Mr. C. F. Nicholls, an educated and observant writer, who has been a practical gold miner. It commences thus:—

"Fascinating as all inquiries are into the origin of things, none are more so than the investigation of the origin of metals, more especially that of gold. Writing from memory, and therefore not giving quotations, I may say that there is good authority for affirming that gold is as widely disseminated over the world as any other metal, if not more so. I have seen as fine and rich quartz specimens from Wales as any in Victoria. Gold has been found in the Wicklow mountains, Ireland, on the Duke of Sutherland's estate in Scotland; and Hungary, Austria, Spain, Russia, Mexico, California, and several other countries, not

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to speak of Africa, have or have had their gold-fields. Silver can be extracted from the ocean, and gold has been found in the roots of the violet and the vine, and sometimes traces have been found of it under such conditions as lead to the conclusion that it must have been in the form or condition of vapour."

When attention was drawn to gold about a quarter of a century ago by the operations of Australian diggers in the sands of the Mahaoya, at Nuwara Eliya and elsewhere, we republished a phamplet by Professor Hopkins of Cambridge, in which the theory was propounded, not that gold was found *in* the roots of trees, but that the precious metals aggregated round the roots of trees and finally took the place of the roots, as particles of ordinary mineral matter replace wood in the so-called "petrifaction" process. This aggregation and replacement must be regarded as processes subsequent to the deposition of both quartz and gold from water (should that theory be tenable,) and subsequently also, perhaps, to the tearing, disintegrating and finally aggregative effects of floods. But we are now dealing with phenomena of comparatively modern dates in geological history and action. The mention by Mr. Nicholls of gold in a state of vapour reminds us of the theory of what we may call original deposition on our globe, and which recommends itself to our reception. We are justified by analogy in supposing that this planet was once what the sun seems to be now, a mass of gases gradually cooling and solidifying. The gases, in the case of our earth as of the sun, included those of the heaviest metals, gold amongst them. As the cooling and solidifying processes went on, it is to be presumed that the various metals agglomerated and settled in masses or strata, according to certain laws of affinity, attraction, magnetism, heat and pressure. The question then arises how much of the gold on the surface of our globe is *in situ*, as deposited during the cooling process, perhaps millions of ages back in time; or whether the whole of it has not been displaced by forces of fire and water: volcanic action and furious water floods; again to form and aggregate under the influence of magnetic and metamorphic agencies? The enquiry is not only curious in itself and in purely scientific point of view. There is a practical aspect of the question: that of the artificial production of gold. The transmutation theories of the dark agee were deservedly laughed at, because they were not founded on a knowledge of the true laws of matter and the right application of those laws. But, looking at the advances made in the manufacture of rubies and even the diamond, he would be a bold man who ventured to assert that science may not yet discover an effectual and cheap mode of compelling the earth to release her stores of diffused gold, as well as inducing the sea to give up her wealth of silver. At present the problem is how to discover aggregations of gold in other minerals or rocks, in such quantities and conditions as to yield appreciable returns for the labour and cost of mining, crushing, amalgamating, etc. Mr. Nicholls points out that but a small proportion of practical miners are able to give much help in solving the problems at issue. Mr. Nicholls seems justified in his blame of the Victorian Government for undervaluing their own great staple. He writes:—

"A reference to the Intercolonial Exhibition essay on mining and mineral statistics, 1866 and 1867, is worth any one's reading, who is interested in the subject, as it brings all the known information up to date under review, and suggests one great defect of the late Exhibition which, so far as it was possible in an essentially gold-mining country, kept that industry in the background, and did in no way help to add to the mining and mineral statistics of 1866-67. The mighty intellects occupied in turning us into a nation of farmers without capital and manufactures without coal could afford to despise an industry that had made Victoria what it is, and employed and sustained directly and indirectly, 60,000 or 70,000 families, producing four millions' worth of raw material, of which three millions were distributed in wages and payment for tools and machinery, and the balance in dividends. The essay referred to will show that there are many modes of the occurrence of gold that were not generally accepted, and, when we remem-

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ber that geologists differ greatly on many points—take, for instance the doubts about granite; is it a primary rock or not? is it the production of water or fire? take basalt, agreeing that it is volcanic, was it mud, and did it crystallize, or was it molten lava?—who knows? Evan Hopkins says, mud, recognized authorities say molten lava. It does not matter much, as either way it flowed out of the bowels of the earth and spread over plain and valley, thousands, probably millions of years ago, filling in the ancient creeks and rivers, covering table-land and mountain, and concealing from us of today the leads, and gutters, and golden lodes of not only a time before history began, but probably before man was. The immensity of time is one of the puzzles, the slowness of the processes, the difficulty of comprehension. Sir J. Lubbock tells us geologists must recast their theories, and base them on a solid world, and the latest theory of volcanic hills is that the bed rock is not thrust up, making a hill, but that the ashes and lava from the rent in the earth's surface are gradually piled up and rounded as we see here in many cases. But, as in most other things, nature does not work in one way only, and whilst in Mount Greenock we have a hill, of that character referred to, so in Wombat-hill, Daylesford we probably have an instance of where the bed rock was raised, and the column of lava burst through the golden lead, and puzzled the miners for many a long day before they picked up the continuation on the opposite side of the solid pipe or column of basalt that had been the out flow of molten lava of overwhelming mud. Spring-hill, Creswic, may be another instance of the thrusting up of the bed rock, whilst Moorookyle and others on Smeaton Plains may have the deep leads underneath them undisturbed. These facts or supposed facts lead to the inference that when we find quartz pebbles on or near these basaltic hills, as at Mount Hollowback, in the Dowling Forest estate, the volcanic forces have burst through quartz drifts and thrown those pebbles out with the ashes, leading to the inference of the existence of probably auriferous leads in the immediate neighbourhood, and where we do not find these rounded quartz or any other, to the existence of deep ground under the hills."

The notice of volcanic forces bursting through quartz drifts and throwing pebbles out with volcanic ashes, reminds us of what we observed, during a journey with a gentleman who owns large possessions on the banks of the Goulburn river (a great wheat region) beyond Echuca, a Victorian border town on the great river Murray. After driving over what appeared to be almost interminable park-like plains, on which timber enough was scattered to give pleasant shelter, we came at last to a rising ground, the manifest result of ancient volcanic action. After admiring the extensive view, w hich included a lake of waters collected in a volcanic depression, our attention was arrested by the curious mixture of bright fragments of quartz with the dark lavas. We said to our friend, who was talking of building a house on the eminence: "We are probably standing over a formation of quartz rich in gold." "Oh! for goodness' sake," exclaimed the fortune possessor of 38,000 acres of fine, freehold property, "don't say a word about gold, or shoals of people will come in and tear my beautiful place into holes and heaps!" Our friend felt he had enough and he did not quite see with us that it was his duty to the colony to give it the benefit of such wealth as might be hidden in his soil. Those who know what the presence of miners on land involves, will not wonder at the objection of the gentleman in question. Mr. Nicholls takes the position that although, quartz is always associated with gold, there are many quartz reefs barren of gold. He writes:—

"We have more barren quartz reefs than auriferous reefs, and as far as we know more quartz reefs that pay handsomely at shallow depths than at great depths. At present it seems as if about a thousand feet from grass is our limit to in most instances payable stone, and yet there is no sufficient reason given to prove that depth has anything to do with the presence of gold in paying quantities or not, and if quartz is the matrix of gold, why should it not continue if our quartz reefs do, as is well-known that they do in several districts, to unknown depths? Gold has been found in granite, in diorite, sandstone, in

slate, and in basalt. May it not be true that our silurian rocks are impregnated with gold more or less, and that though under special circumstances there is an accumulation of the metal in occasional quartz reefs and dykes (as at Wood's Point), the denudation of immense areas of bed rock for countless ages may have had much to do with the formation of our alluvial leads, helped by the breaking down of rich quartz reefs but not entirely dependent upon them. The processes of nature are not only varied but repeated over an extension of time we cannot realize, and under the same as well as different conditions; hence the many puzzling facts that no one theory accounts for. I have seen nuggests taken from the Hard-hills, Buninyong, without a particle of quartz, looking as if they had been poured out of a ladle in a molten state on to the bed rock. The last gold I obtained was a working miner at the head of Cobbler's Gully, Cresick, consisted of a run of coarse gold and nuggets, looking as if they had undergone enorous pressure and grinding force, found on the shoulder of the bed rock, and a few feet deeper, packed against a quartz reef that we could see no gold in, was 3 ft. of washdirt containing nothing but fine gold, as if it had dropped out of a quartz reef a few days before we discovered it. The coarse gold came from a yellow bed rock, the other rested on a white pipe-clay gutter, and crossing this gutter were several bands of hard greasy pipe-clay of an inch or two in width carrying a good deal of gold. Here were three distinct deposits of gold all within a few feet of each other. Is there any theory that accounts for the facts? I have taken out of the bed of the saltwater river at Gisborne and other places large flat pebbles that have in a single pebble contained a perfect miniature system of the five Clunes quartz reefs, and other pebbles showing in miniature quartz reefs of many different kinds. What are we to understand by this? Some of my scientific friends may explain it. I can only record the facts. At Creswick and Ararat with all the enormous amount of alluvial gold taken out I hardly know of a quartz reef that is paying expenses. As Artemus Ward might say, 'Why is this thus?'

"What we do know amounts to this. So far as quartz reefs are concerned they may last to any depth and they may run out at any depth, both quartz and gold, or the quartz may continue and the gold give out, but when the quartz runs out the gold never continues. Some quartz reefs run with the strata and some across the combs of the bed rock. Some thin out at all sorts of depths, and some make again and some do not. Some continue well defined to great depths, but the gold runs out. They all vary in yield, but some continue to pay and some do not. In the upper silurian bed rocks we have, as a rule, small but rich reefs with some notable exceptions, like the long Tunnel Reef, Walhalla; and in the lower silurian, as on Ballarat, the main body of the stone is poor and the spurs from it are rich, and so on *ad infinitum*, which to some extent justifies the practical miner, who says of gold, 'Where it is there it is, and you have to work to get it,' but we may do so with all the lights of ascertained fact, or go groping about here and anywhere in a costly and expensive bewilderment."

He goes on to say that the unknown may be inferred from the known; that there are belts of ascertained auriferous country and the richest and longest continued lines *run north and south*. Mr. Nicholls states:—

"Whether gold travels far or not I think depends upon the forces brought to bear upon it. If the forces are strong enough to gouge out the bed rock the fine gold will travel with the clay and *débris* as long as that force continues. I have seem a flood at Clunes that carried a twenty pound lump of basalt rock half a mile, and that washed away a heap of puddled washdirt, but did not carry the gold fifty yards. As to alluvial deposits, I have found payable gold in the grass and black soil, and no payable quartz reef in the neighbourhood; I have seen gold in the black clay in Melbourne on the top of the basalt, but what we know is that the east and west runs of gold pay out; that the north and south runs of gold continue apparently so long as they twist

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and turn within the area of one or more belts of auriferous country, as the Golden Point lead did and as the Creswick, Kingston, and Smeaton leads are now doing."

Wherever gold is found, the lines north and south of it should be followed. The conclusion is startling, and will, we suppose, be disputed. It runs thus:—

"In conclusion, permit me to say that all reports based upon the yield of gold per ton are illusive unless the cost of obtaining the gold is stated. Returns from Anderson's Creek, Diamond Creek, Gipps Land, and Reedy Creek would surpass anything from the neighbouring colonies if compiled in the same way, but 'distance lends enchantment to the view.' There is one test that may fairly be applied as between Victoria and any other colony. Let the investor ascertain how many dividend-paying companies there are in Tasmania and New South Wales, or (what is the same thing) the percentage of profit on the total investment in each colony, and I do not hesitate to say that whilst in Victoria we can show a profit of sixty per cent. upon our total expenditure for 1881, that the neighbouring colonies cannot show any profit whatever on the total expenditure for the past year."

Our own opinion is that, in the other Australian colonies as well as the golden colony, *par excellence*, Victoria, the use of the diamond drills will develope mineral wealth rich beyond experience or even imagination.

As regards Ceylon, the question is: have leads of auriferous quartz yet been discovered, rich enough to justify the introduction and use of machinery, for sinking shafts, including not only ordinary borers, but that true "divining rod," the diamond drill? The presence of one in Ceylon might give the country Artesian wells, where water is wanted, even if payable gold reefs failed to be discovered.

"GOLD IN CEYLON."—We are indebted to a correspondent signing "Granite" for the following:—"A quick and inexpensive method of testing quartz is much needed at the present time. Here is one: take a candle and a blowpipe and apply the flame to the face of a promising lump of quartz, concentrating the heat on one particular spot for three minutes more or less. If there is gold, it will very shortly become coated with the precious metal. 'Contrary, no.' This test I have seen applied to good specimens of silver ore, with the result, as may be supposed, of completely plating the heated surface. Having fancied that the ardour of the gold-seekers was abating somewhat, I have sent this note, and am in hopes it may give a fillip to their flagging zeal."

QUEENSLAND PEARL FISHERIES.—From a report recently issued on the pearl fisheries of Queensland by Lieutenant de Hoghton, of Her Majesty's ship "Beagle" we learn that 11 firms are engaged in the trade in Torres Straits, of whom ten have their headquarters at Sydney, employing nearly 100 boats in the work. The amount of pearl-shell exported in 1878 was 449½ tons, valued at from £60,000 to £70,000. The price of the shell fluctuates a good deal, ranging between £120 to 280 per ton. The divers principally consist of Kanakas, Maories and Malays, only some 20 white men being engaged in the operations, with a few Australian blacks. Generally speaking, the divers make an excellent thing of it, their earnings seldom being less than £200 a year, while in very good years, such as 1878, they have been known to make £340 each. Although there are a good number of sharks in these seas, the loss of life on the part of the pearl fishers is very small, averaging about two per annum; and it is a curious fact that the sharks almost always beat a retreat as soon as the fishing operations commence.—*London Times.*

GOLD, GEMMING AND PLUMBAGO IN THE WESTERN PROVINCE.—The discovery of precious stones in new districts has led to increased activity in their search, and as afforded employment, and a precarious means of living to a large number of natives both in the Ratnapura and Kalutara Districts. The law regarding the rights of the Crown and the proper means to be adopted to stop gemming on Crown lands has for a long time been in an

unsettled state. I am happy, however, to be able to say that at last a partial remedy has been discovered by criminal prosecution under the 19th clause of the Ordinance 6 of 1846, relating to malicious injuries to property, and the wholesale depredations which were committed, by persons, not stealthily but in gangs of several hundreds, have now been checked. There is, however, no doubt that a special Ordinance is necessary, embodying the provisions of the Proclamation by Sir Edward Barnes dated 9th December, 1826. Sir R. Morgan stated in Council in 1872 that this Proclamation had still the force of law and was a very useful measure, but it has been found impossible to give effect to it; and as I believe that almost the only printed copy extent is in my possession, I shall be glad if greater publicity can be given to it by printing it as an appendix to this report. (*Vide* B.) The discovery of gold in the neighbouring continent of India has re-opened discussion of the question whether gold in appreciable quantities exists in Ceylon. For my own part, I have little doubt that it does so exist in the Sabaragamuwa District of the Western Province. In 1869, when stationed at Ratnapura, I collected some gold from the stream which ran through the Government premises, and forwarded it through Sir Charles Layard to Mr. Brough Smyth. That gentleman, whose opinion is authoritative, stated that the small pieces of gold were real "nuggets," and had not travelled far and that he had no doubt a careful search or prospect in the neighbourhood would be repaid. When visiting Ratnapura in the early part of this year, I procured some more gold collected from the same spot, and sent it through Mr. W. Ferguson to Mr. Macdonald Cameron, and the report of that gentleman was equally favourably. The attention of Government, I believe, has been already called to the necessity for framing rules to regulate and define the rights of private persons to gold found on private or on Crown lands, and it is not necessary therefore to say more on this subject. The Government has been successful in a suit taken before the Privy Council in appeal from the Supreme Court of Ceylon for the recovery of a valuable tract of land containing plumbago at Pelpitigoda in the Kalutara district, and, as before stated, 37½ acres of this land have been sold for 35,851 rupees, an average rate of 968 rupees per acre. This would seem to shew that the plnmbago is of superior quality.—*Mr. Saunders' Report for* 1880.

GOLD ON THE NILGIRIS.—Assays of Nilgiri quartz were made by Mr. F. Claudet, Assayer to the Bank of England:—

	ozs.	dwts.	grs.		
The best result was ...	2	12	12	gold.	per ton of quartz.
and ...	1	12	0	silver.	
The worst result was ...	0	10		gold.	
and ...	0	9		silver.	

The other three assays were made by Messrs. Johnson Matthey & Co., Assayers to the Bank of England, and H. M. Mint:—

	ozs.	dwts.		
The best result was ...	3	5	gold.	per ton of quartz.
do ...	1	10	silver.	
The worst result was ...	0·250		gold.	
do ...	0·100		silver.	

Mr. C. Harvey saw some of the quartz from these hills in England, and said that it was some of the best stone he had seen from India. I have been shewn the results of panning pounded quartz, and of sand in the rivers, near these reefs, and also in one case of the surface soil, on a very reefy looking bit, contiguous to a reef; and the results, judging from what I have seen in other places, were simply splendid in every instance. I have also been shewn several very fine specimens of gold that were taken from these hill reefs. With the immense natural advantages that there are on these hills, in point of climate, water, position, and local labor, it is a wonder that the investing public have not

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been induced to turn their attention to these parts, or that our wealthy Australian cousins have not paid us a visit. When once this new industry is started up here,—and surely some one will be enterprizing enough to try it soon, however slow they may be in getting results in the Wynaad,—it will give a tremendous impetus to every branch of work up here, and it would not be long before we had the train running up to Coonoor, with or without the help of Government.—*Cor., Madras Mail.*

Gold in Ceylon.—Interest in our quartz reefs will be revived by intelligence received from England. Samples amounting to one-fourth of a ton of quartz from Rangboda Estate in the Ramboda district has been found, on analyses by the Assayer to the Bank of England, to contain as much as two ounces of gold to the ton. A further large sample from the same locality is now on its way home, and, if the test prove equally satisfactory, no time will be lost in commencing mining operations. The enterprise could not be begun under better auspices, and we have not the slightest doubt that when capitalists realize the facilities of ready transport and cheap reliable labour as well as of healthy climate which exist in Ceylon, that not alone in respect of gold-mining will British Capital once again begin freely to seek investment in the country. Our new products—tea, cinchona, cocoa, rubbers, &c.—challenge attention on all sides.

Mica.—A German manufacturer of mica wares, Herr Raphael of Breslau, now makes mica masks for the face, which are quite transparent, very light, and affected neither by heat nor by acids. They afford good protection to all workmen who are liable to be injured by heat, dust, or noxious vapours, all workers with fire, metal and glass melters, stone masons, &c. In all kinds of grinding and polishing work, the flying fragments rebound from the arched mica plates of the mask without injuring them. These plates are fixed in a metallic frame, which is well isolated by means of asbestos, so as not to be attacked by heat or acid. These masks allow the turning of the eyes in any direction, and, as against mica spectacles, they afford the advantage of protection to the whole face. In certain cases, the neck and shoulders may also be guarded by a sheet of cloth impregnated with fire-proof material, or by asbestos sheet, attached to the mask. The interval between the mica and the eyes allows of workmen who have poor eyesight wearing spectacles, and of workers with fire or in melting operations wearing coloured glass spectacles under the mask, without fear of breakage of the glass mica being such a bad conductor of heat.—*Home Paper.*

Test for Gold.—In the present great search for gold in Ceylon the following test, taken from the *Public Opinion*, will be read with interest:—"There is a simple method for the detection of gold in quartz, pyrites, &c., which is not generally described in the mineralogical text-books. It is an adaptation of the well-known amalgamation process, and serves to detect very minute traces of gold. Place the finely-powdered and roasted mineral in a test tube, add water and a single drop of mercury: close the test tube with the thumb, and shake thoroughly and for some time. Decant the water, add more and decant repeatedly, thus washing the drop of mercury until it is perfectly clean. The drop of mercury contains any gold that may have been present. It is therefore placed in a small porcelain capsule and heated until the mercury is volatilised, and the residue of gold is left in the bottom of the capsule. This residue may be tested either by dissolving in aqua regia and obtaining the purple of Cassius with protochloride of tin, or by taking up with a fragment of moist filter paper, and then fusing to a globule on charcoal in the blowpile flame. It is being shown that gold is much more universally distributed than was formerly supposed. It has recently been found in Fulton and Saratoga counties, New York, where it occurs in pyrites. It has also been discovered in the gravel of Chester Creek, at Lenni, Delaware County, Pa. In one of the Virginia gold mines wonderful richness is reported 160,000 dols. worth of pure gold having been taken from a speck of three square feet."

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INDIAN GOLD MINING AND ITS PROSPECTS.*

QUARTZ OUTCROPS OF TRAVANCORE.

First, then, in point of time, we have the report of the committee appointed by the Indian Government on December 14th, 1832, to examine the gold mines in the Zillah of Malabar. They allude as follows to the geological features of the country:—"Nearly the whole of the province of Malabar except that part immediately along the coast consists of lofty mountains covered with dense forest or thick jungle. The principal chain more immediately connected with the present subject is formed of the Koondah and Moor Koorty Hills to the south-east of Calicut, the Nilgiris to the east and the Wynaad mountains to the north-east. These send off numerous lateral ranges, between which are deep valleys, in most places closely covered with forest. The most extensive of these is that of Nellámboor, including nearly the whole of the Ernaad Taluk, bounded on the east by the Neilgiris, on the north by Wynaad, on the north-west by a lateral range running south from the Ghauts called the Wawoot hills, and on the south by the Koondah and Moor Koorty mountains. From these on all sides innumerable mountain streams descend, and meeting near Nellamboor form the Beypore river of considerable magnitude, which falls into the sea about eight miles to the southward of Calicut. In the mountainous districts of Wynaad, streams in the same manner descend through every valley, and unite into lager rivers which fall into the Cauvery in the Mysore and Coimbatore countries. The whole of the mountains above metioned seem to be of primitive formation. In the Nellamboor valley, so far as the observations of the committee went, the prevailing rock is gneiss, a kind of stratified granite. Above this in most places is a species of clay-ironstone, which from its softness enabling it to be cut into the form of brick for building purposes, received from Dr. Buchanan the name of laterite. It is what geologists call the overlying rock of the whole country, between the Ghauts and the sea to the westward, and many of the smaller hills are formed of it. When first dug it is perfectly sextile, but on exposure to the heat of the sun and to the weather it becomes of considerable hardness. So far as the gold mines are concerned it may be considered to be a deposit formed in the lapse of ages, from the gradual disintegrations of the immense mountain masses in the neighbourhood, in which process part of the precious ore may be supposed to have been worked over along with the earthy particles. However this may be it is certain that gold exists more or less abundantly in the whole of the country on the western side of the Ghauts in every stream which takes its rise from the Koondah, Neilgiri, and Wynaad mountains, and in the sands of the sea-shore along the whole of south Malabar it is throughout in the form of minute grains."

Further on in the same report the committee in alluding to the geological formation of the country in the neighbourhood of the Beypore river, near Mamboot, say—"the superstratum consist of sand and gravel, below which are large nodules of quartz and gneiss."

Mr. Brough Smyth, in his report on Wynaad gold fields, alludes to the lithology of the gold district as follows:—"The granatoid schists or the gneissoid rocks of the south-east Wynaad are, it is probable as will be shown hereafter, only completely metamorphosed sedimentary strata. The minerals observable are felspar, quartz, hornblende, mica, talc, chlorite, pholerite, and magnetic iron. The ordinary foliated rock usually massive, or composed of thin impact layers of quartz and felspar or of quartz and hornblende. Magnetic iron takes the place of one or other of these constituents or accompanies them in some places; and at, and in the neighbourhood of Marpanmadi, North peak, magnetic iron is largely present in the rock, the decomposed surface stone exhibiting layers

* By J. Macdonald Cameron, Fel. Inst. Chem., F.C.S., etc. (late Assistant in the Chemical Laboratories of the Royal School of Mines).

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and reniform, and nodular masses of sesquioxide of iron. Some specimens are composed almost entirely of quartz and magnetic iron, and in others the iron occurs with qurtz and felspar, and again there is a variety composed of translucent quartz, maganetic iron, and an asbestiform mineral resembling iron amphibole."

Again, Mr. Oliver Pegler, in his report on the Wynaad gold fields, alludes to the geologic characteristics of the district, as follows:—"The range of mountains, on which is situatad the Wynaad district, is of very ancient date, belonging to the Palæozoic period, more especially to the Silurian formation. The highest peaks of the range, as in the neighbourhood of Otakamunde, are formed of hard dense dark crystalline rocks of the metamorphic series of granites and syenites, the more fissile varieties of which are also here present, and are softer, and, having thus yielded to the disintegration and denudation of time, have formed the valleys and dells adjacent to the peaks. These softer rocks are of a much higher colour than the harder granitic crystalline formations, and give a reddish brown appearance to many portions of the surface of the country. Before leaving this portion of the Neilgiris for the more auriferous districts of the Wynaad, I may observe that the whole of the formations are impregnated with black magnetic oxide of iron, which after a shower appear as black sand on surfaces where the rain runs over in streams of water, and this is very noticeable along the roadsides."

I have, now, I think, quoted sufficient from the reports of these several authorities to show what are the geological and lithological features of that gold zone of which in view of recent discoveries, the Wynaad may be considered as forming the centre. The commission of 1882 and Mr. Brough Smyth agree that the leading rocks of the Wynaad and Nilgiri districts are composed of granatoid, schists, and gneiss rocks, and as a consequence there can be no divergence of opinion as to the mineralogical constituents and industrial products of these rock outcrops, but Mr. Pegler says the range of mountains upon which the Wynaad is situated belong to the Silurian formation of the Palæozoic Period, though he admits that the highest peaks of the range are formed of hard, dense, dark crystalline rocks of the metamorphic series of granites and syenites. This is somewhat conflicting, but the weight of evidence as regards the lithological characters of the Wynaad places it in the metamorphic system, and hypozoic period. We shall now see how far the characteristics of the Wynaad district agree with those of Travancore. The Ghauts as they pass southwards through the latter country send out, as in the Wynaad, numerous lateral spurs or side branches between which there are deep valleys or gorges covered with dense jungle, and in a region with such an abnormally high rainfall there are consequently numerous streams which have cut through the country rock in some places to considerable depths, laying bare its structure for the eye of the geologist, and gathering strength from their innumerable tributaries, every yard traversed they form rivers of no mean dimensions ere they lose themselves in the bosom of the Indian Ocean. The height of these Ghauts varies from 1,500 to 5,000 ft. occasionally forming comparatively gentle declivities, but as a rule they stand out in bold escarpments perpendicular to the horizon. The escarpments usually face the west and south-west, the points from whence come the annual monsoon rain-storms. The most prominent are the Ibex Hills which are passed on the left of the district road proceeding southwards from Augustier estate to where the river is crossed at the foot of Auldbar estate, and also on the opposite side of the same river to the left front of the superintendent's bungalow. A still bolder and more prominent escarpment, however, is to be seen in the southern portion of Assamboo district below Retreat bungalow. It is almost perpendicular and several hundreds of feet in height, and the river which now washes its base has doubtless been an important factor in giving rise, at any rate, to a portion of its present contour, for, here a deep gully

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has been formed, and the rocks on the opposite side of the stream, which are of the same series, show evidences of having once been part of this precipitous mountain mass.

As the geology of Travancore has up to the present, 1881, been very little studied, and, so far as I am aware, its palæontology less so few, if any, fossils have been found, especially in those strata which flank the upper portions of the Ghauts, consequently considerable difficulty presents itself in deciding whether many of its schists belong to the Palæozoic or Hypozoic periods. All that the geologist has at present to guide him is the lithological characteristics, and these, so far as I have been able to decide, place the various strata of which some of the lower ridges and square are composed, and many of those that constitute the higher peaks in the metamorphic system, and within the Hypozoic period.

The Government committee of 1832 found the prevailing rocks of the Wynaad and surrounding districts to be gneiss and a species of clay-ironstone called laterite. Now anyone who for such a short period of time has sojourned in Travancore could not fail to be struck with the presence of this latter rock. Nearly all the houses and offices of the common people, and the bungalows of even the well-to-day natives and Europeans are built of it. It will also be seen from what I have quoted of Mr. Brough Smyth's report that he says the rocks of the Wynaad district are "granatoid schists or gneissoid rocks;" and Mr. Oliver Pegler also admits that "the more fissile varieties" of the metamorphic series are present, "and are softer, and having thus yielded to the disintegration and denudation of time have formed valleys and dells adjacent to the peaks. These softer rocks are of a much higher colour than the harder granite and crystalline formations and give a reddish brown appearance to many portions of the surface of the country."

Who that has seen those parts of Travancore which has been converted into coffee gardens has failed to notice the soft gneissic rock studded with small nodules of quartz, varying in size from that of a pea to that of a walnut, and which, when exposed to atmospheric influences, have had their felspathic constituents decomposed, leaving the quartz scattered over the ground? This soft gneissic rock is essentially the rock to whose decomposition, through the lapse of ages, the coffee soils of Travancore are due, just as surely as it is the source of those of the Wynaad and Nilgiri districts. Where the rock is impregnated with a large amount of ferruginous compounds the resulting soil has a yellowish or reddish-yellow colour, and where these iron compounds are absent in the under-lying rock the colour passes to that of kaolin or potter's clay.

Chemical and Metallurgical Laboratory, Lime-street, E. C.—Mining Journal.—Madras Mail.

PEARL FISHING IN THE TORRES STRAITS.

(By "The Vagabond" in the *Australasian.*)

With the exception of some parts of Otago, Torres Straits is the most inhospitable place I have visited in the world. During my enforced detentions at Thursday Island, I much wished to examine the workings of the pearl fisheries. I should like to visit some of the "stations" and describe the strange phases of life thereon. I desire, above all, to give reliable information and statistics relating to this industry. So with the assistance of the Professor, I issue a circular letter to the proprietors or managers of all the stations, asking for particulars which I consider would be interesting to the public, and hinting that it is my desire to inspect some of the stations, although the time at my disposal prohibits my visiting all. This may be said to be fishing for invitations; perhaps I mean it in that light. It is the same sort of letter which I had despatched from Townsville to all the sugar planters in the district, and to which, in most cases, I received full replies. I also received pressing requests to visit many of the plantations and see how the Kanaka labourers are treated.

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This, as I have stated, I take to be a proof that the managers and owners consider that they have nothing to conceal from the public. How is it in Torres Straits? I receive only one reply to my letters, and not one single individual amongst the pearl-fishing "bosses," whom I meet at the store or the hotel, has the courtesy to offer me a sail in his boat, or invite me to visit his station. I apply to officialdom for information, and it is not supplied to me. I have travelled in many lands, and never had such discourtesy shown to me as here. There must certainly be a reason for this. One pearlfisher informs me that my advent and the letters I send have created quite a scare in the Straits. "A few of us held a meeting, and we decided that it should be generally understood that we would not answer your letters, and that you should be kept away from the stations and fishing grounds." "But why send me to Coventry in this way?" I ask, astonished. "Well you see, you have the reputation of writing strongly, and we don't want to be stirred up. Personally, I am very pleased to meet you. Let's have a drink." I decline this *solatium* to my injured feelings, and at once set to work to find out what there is to conceal in the working of the Torres Straits pearl-fisheries.

Melbourne capital and Melbourne interests are largely represented in the sugar districts of Northern Queensland. The pearl-fisheries in the Straits have been established by, and are essentially in the hands of Sydney firms. There is a great difference in the public opinion of Victoria and New South Wales. Outspoken journalism is not relished in the sister colony. But that can hardly account for the treatment I receive in the Straits. Little by little I find out what is the evil on the pearl-fishing stations which it is hoped to hide from the world. Standing at Burns, Philp & Co.'s store, talking to gentlemanly captains, who have just come ashore from the elegant yachtlike boats anchored in Port Kennedy, I see case after case of spirits carried down to their dingies. Extra preparations, perhaps, are now being made for the Christmas holidays, but all the year round the stores of a fishing station include an abnormal amount of liquor, which is supplied to the hands employed, divers and crews of the boats. I am told on good authority that the amount of drinking on many of the stations is something frightful. Many station stores are only private grog-shops. The crews of different boats buy cases of liquor from their employers, meet at some island, and have a day's debauchery, as regularly as some English artisans keep Saint Monday. Drink is the curse of the Straits, and an act ought to be passed prohibiting any strong liquor being supplied to the Malays and the islanders employed in pearl-fishing. It is bad enough to see Malays and Polynesians come to the hotels here and get bottles of grog, with which they retire into the bush to get drunk and quarrel amongst themselves, the knife occasionally being called into play, but on the lone islands in the Straits, supplied with cases from the station stores, I am informed that there are at times veritable scens of Pandemonium. The loss to employers in this waste of time is of course very great, but the custom of supplying men with liquor for an occasional spree sprang up at the commencement of the pearl-fisheries. Employers argue it is better to give the men liquor and let them have their saturnalia over on the station or some lone island, where, when it is over, they will set to work again, than to let them go to Thursday Island and spend their money at the pubs there, with the difficulty of getting them back to the scene of their labours. Liquor, it is said, these men will have. If one employer attempts to run his boats on Blue Ribbon principles, the men leave him for others where there is periodical grog and a spree. There is no doubt, that, to counterbalance the loss of time, a large profit is made out of the sale of grog to the men, and that many of them, by drinking up their wages, are kept from leaving. Some employers, I daresay, are heartily sick of the system. They should arouse public opinion and a bond should be signed by every owner and manager that no strong drink should be supplied to their hands.

Until 1878 the islands in Torres Straits formed an Alsatia for European

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"beach-combers," runaway sailors, discharged Polynesians, and Malays. They worked a little at bêche-de-mer fishing, and spent their earnings pricipally in grog, which was supplied to them from Cooktown and Thursday Island free of duty. The majority of the pearl-fishing stations thus also obtained liquor at a cheap rate, and so the evil, which is now the curse of the Straits, grew up. In 1877 Mr. Chester suggested that he should be appointed a deputy-commissioner for Western Polynesia, so as to exercise supervision over the beach-combers, and he was accordingly so appointed by Sir Arthur Gordon; but in 1878, on the proposal of Mr. John Douglas, then Premier of Queensland, the "maritime boundaries" of that colony were quietly "rectified" on the assumption that police authority might be exercised over doubtful characters in the Straits. The Queensland shores were then some 60 miles from New Guinea. Now Queensland's boundary comes to within four miles of the New Guinea coast. The boundary line runs northward outside the Great Barrier Reef to Brumble Bay; thence westward to Saibai and Talbot Islands, extending for half a degree within a few miles of the New Guinea shore; thence extending to 138 deg. long. east, and running south into the Gulf of Carpentaria. It will be thus seen that Queensland has possession of Torres Straits, the toll-bar between the east and the west, the Indian and Pacific Oceans, a highway of yearly increasing and important commerce. With this annexation the days of cheap grog in the Straits were ended. The measure, which Mr. John Douglas innocently or artfully described as one merely of moral expediency to provide for proper police surveillance of the Straits, has not only proved to be one of the greatest importance to the colony in giving it entire possession of the Straits, but has also added many thousands of pounds to the Queensland revenue. The 60 or 70 boats engaged in the bêche-de-mer trade, sailing out of Cooktown, cannot clear out with bounded spirits as formerly. The customs receipts at Thursday Island have been swelled to an amount which makes this a first-class port. The protection policy is so fully carried out that a schooner which sailed up from Sydney the other day was charged £7 10s. *ad volorem* duty for the fixed pump on board connected with the diving-gear. This is as much part the vessel as the sails and ropes. But the revenue of Thursday Island is principally derived from the duties on strong liquors, and the sooner there is a falling-off in this respect the greater will be the direct and indirect moral and material benefit to all concerned in Torres Straits.

Afar off I survey the stations in Torres Straits, but, "boycotted" as I am, I cannot visit them. It makes me mad to see the boats come sailing in and out whilst I am detained on dry land. The only craft for hire belongs to Jasper, the Malay, and his charges are exorbitant. Mac should have a boat of his own for the benefit of visitors. There is one small station on Thursday Island itself which I am enabled to visit. This belongs to Captain Edward Parkyns, lineal descendant of the Saxons who found the body of Rufus the Red in the New Forest, a Winchester boy and grand old veteran. His hair and beard are silvered, but he is hale and hearty as men half his years. Not at all of the "Father William" type is this Hampshire skipper. He never led such a stupid, inane life. He receives me heartily, and answers all my questions. He has been a long time in the Straits, and knows the pearl-fisheries from their commencement; has now four boats, and 28 men employed. As usual on all the stations, the nationalities are mixed—all sorts of Malays and all sorts of Kanakas. The Loyalty Island boys are the best; those from Mare preferred. Rotamah boys were the best in the old days, but they cannot be got now. Wages average £2 10s. a month, but the divers also get paid according to the take, and earn very large sums. Grog is the only thing which prevents boats being worked profitably. Each boat should get at least seven tons of shell a year to leave a margin over expenses. Price in Sydney over £130 to £140 a ton. Thus Captain Parkyns. The only gentleman who has the courtesy to reply to my letters is Mr. Pearson, the Manager for Captain Tucker, of Sydney, who owns Goode Island. This station is situated three miles from Thursday

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Island, north by west. There are five dwelling-houses on the island, and five large stores. A sea-wall runs in front of these. There is a wharf 350 feet long from the shore to deep water, and a patent boat-slip, which can take up a vessel of 30 tons. Two large paddocks for sheep are securely fenced. Thirty thousand coconuts have been planted on the island, and the planting is still going on at the rate of 250 a month. Seventeen boats and one tender are employed in connexion with this station. Once a fortnight the tender goes out to the boats fishing on the reefs and collects the shell: 140 men of various nationalties are employed. Mr. Pearson prefers the Malay and Manilla men. The take of pearl-shell per year is about 160 tons, value in Sydney about £140 a ton. Mr. Pearson says:—"Annexation will not affect us at all in the Straits. New Guinea natives will not work away from home, although I believe they will work well on their own coast. Some have been tried in the fisheries, but the experiment did not succeed."

When one reads of the improvements carried out by private enterprize on Goode Island, and sees that on Thursday Island absolutely nothing has been done for the public good, one is apt to query the benefit derived from the sway of the Queensland Government in Torres Straits. I have given one sample of a station, but on the surrounding islands the stores and habitations are, I am informed, all of a superior order. The storing, sorting and packing of the pearl-shell is the principal work on a station, which otherwise acts as a warehouse for provision and grog. At most of the stations, stone or wooden wharfs have been constructed, and in some instances tramways and slips have been built. It is estimated that 170 boats are employed in the pearl-shell fishery in the Straits. I am told "the vessels in use are probably the finest and best found and fitted of their kind afloat; they range from 10 to 30 tons capacity, are excellently built, carefully equipped, splendidly handled, and are a credit to the colonies." Sydney capital is mostly employed in the pearl-fishery. The tax paid to the Queensland Government for occupation of each station is £5 a year, £6 a year for each boat, and £1 a year for each diver. This, with the indirect contributions to the revenue through the consumption of spirits, &c., proves that the pearl-fishery pays its fair proportion of Queensland taxation. There is a difficulty now in obtaining good sites for stations. All the best islands are occupied, and on many there is a great want of water. Good anchorage and landing-places are required, and most of these are pre-emptied. It is held to be essential that a station should be within easy distance of the fishing-grounds and of Thursday Island, so that the boats can be readily reached by tenders and the shell be despatched to the port. I think it possible that a small steamer visiting all the fishing-grounds would be an improvement on the present system.

There is no mistaking the importance of the pearl-fishing industry in Torres Straits. It gives employment to some 1,200 persons, and supports the commerce of Thursday Island. The bêche-de-mer boats, between 60 and 70 in number, mainly belong to Cooktown. The Chinese merchants there buy up this fish, and give a better price than can be obtained on consignments sent to Singapore. It is some years since the practice of diving for pearl-shell was abandoned. The resources of science have simplified the mode of operation. Diving-dresses and air pumps are now employed, which means that increased capital has to be expended. The cost of working a pearl-fishing station now is double what it was ten years ago. There are more stations and more boats employed, yet the take of shell is no larger than it was years back. This means that some men made very large fortunes in the early days, and that some are losing money now, for with the present appliances there ought to be a large increase in the returns. I read that "the shell can now be traced from the shallow waters of the shores, where formerly it was only possible to recover it by swimmers, to the deep waters of the Straits. The bulk of the pearl shell is now recovered from 13 to 15 fathoms of water. The area of distribution has been found to be very extensive. Pearl-shell has been traced all along the New

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Guinea coast, across the Straits and the Arafura Sea, and eastward from New Guinea to New Britain and the Solomon." There should be promise of a permanent and lucrative future for the trade; but all the old station-holders grumble. It is certain that now-a-days a great deal of capital has to be expended, and that the returns do no more than recompense the time and tact necessary in supervision. There are no rapid fortunes made as in the days when shell was worth £200 a ton and expenses were slight, naked divers fetching up the spoil from the deep, risking their lives at every plunge. Now the divers walk along the bottom in the latest dress, ugly enough to scare away all sharks and devil-fish. They now, too, know the value of the pearls, and, should any choice ones be discovered in the shells, there is little chance of the owners of the boats getting them. But the old hands grumble principally, I think, with the hope of keeping away competition. You may take up a good station on an island in the Straits, and in that respect have great advantages over your rivals, but the waters and reefs are free to all. Rival fishing boats can anchor side by side, and often do so, and when one strikes a new patch of good shell there is often considerable ingenuity displayed in endeavouring to deceive all other comers. The pearl-fishery now is certainly not the good thing it was to a few Sydney capitalists, but a great deal of money is now circulated amongst the many in Torres Straits, and the industry is not by any means played out.

GOLD IN CEYLON.—We have within the last few days had a second visit from Mr. Harvey of Australian goldmining repute, who called here on his way from Melbourne to Southern India with a party of miners from Victoria, whose services he has secured for one of the Wynaad Gold Companies, with which he is connected. His visit to the gold fields of India will be brief, probably for not more than two months, as he has other work in view elsewhere. Mr. Harvey has not changed his opinion of the value of the auriferous deposits in South India. He continues to speak of them as formerly, as being of a varied character—a portion exceedingly rich, a portion of indifferent quality, and another portion as likely to prove worthless. The great difficulty in the Wynaad is the absence of good roads, and Mr. Harvey is decidedly of opinion that a much smaller percentage of the precious metal will pay in Ceylon than in India, in consequence of our having such excellent roads in all directions, thereby lessening the cost of transport, and facilitating access to any gold reefs that may be discovered. During his recent stay in Colombo this gentleman examined a large number of quartz samples submitted to him, the produce of different districts, and although the greater portion of these were pronounced by him as cold and valueless, there were others which immediately struck him as giving promise of some practical results. These samples bore a strong resemblance to the gold-yielding quartz of Southern India, having that peculiar colour about them which betokens the presence of ore of some kind, in many cases sulphur with appearances of copper. But of course an examination with the eye is not sufficient to pronounce upon the probable value of a small sample, and when Mr. Harvey was requested by one Colombo firm to pay a visit to a district from which a very promising sample had been taken, he pointed out the necessity first of a further exploration of the locality, so as to expose a certain depth of the reef, to enable him to come to something like a conclusion on the subject. Mr. Harvey left by the Bombay steamer for Tuticorin whence he will proceed to the Tambracherry estate, for which property he is chiefly acting, and for which he is taking the miners engaged in Australia. During his absence of six weeks or two months, explorations will be made in several localities with a view of enabling him, on his return in February, to give something like a practical opinion on the value of the samples raised; and we may add that Mr. Harvey thinks it extremely probable that gold may be found in Ceylon which, with our advantages, may be worked to a profitable account.—Local "Times."

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GEOLOGY AND MINERALOGY OF THE BASIN OF UVA:

GOLD, MARBLE, PLUMBAGO, AND IRON ORE.

FERRUGINOUS PROPERTIES OF ITS ROCKS AND SUITABILITY FOR TEA, &C.

SIR,—By parcel post I send you samples of various minerals obtained in a short exploration of the hydrographical basin of Uva, and would be very pleased to have your opinion upon them.

The gold, you will observe, is imbedded in *schlorite schist*, where I had not expected to have met with it in such large quantities. Whether it be prevalent, or is only sparsely distributed in this class of rocks, I am unable yet to say. The other minerals, with the exception of the marble. I may state, are not partial deposits, but extended over a wide extent of distrtct, and I am of opinion that in this peculiarly formed basin lies a considerable amount of mineral wealth, requiring only roads and railway communication to open up and develop new and important industries in the island.

I regret that I have been unable to procure in Ceylon the necessary materials for polishing the marble; consequently, I have only been able to operate upon it as far as to enable me to perceive that it is capable of receiving as brilliant a polish as the famous marbles of Sicily and Carrara. By leaving it, however, a few minutes in a basin of water, and then holding it at an angle towards the light, you will be able to realize the same effect ti would exhibit on being polished.

The patana hills, for the most part, consist of *trap* rocks, and, with the exception of the slopes of the encircling mountain range (the mineral formation of which is chiefly *gneiss*, or its varieties), are as a rule barren and too deficient in carbon for the cultivation of vegetable products generally, but some fine alluvial deposits are to be met with on the *flats*, and in the valleys and hollows of this wide tract of country thousands of acres which only await capital and European enterprise; and, in my opinion, are better adapted for the cultivation of tea than many kinds of jungle land, if ferruginous soil be considered a desideratum. Although this property may be the general characteristic of the soil in most parts of the island, I think that the soil of the Uva basin possesses it to a much greater extent than any other part of the country with which I am acquainted, unless it may be the *subsoil* around Colombo, which chiefly consists of *laterite*, *i.e.*, decomposed trap, with red oxide of iron, the same which constitutes the soil of the trap rocks of Uva.

There are, however, two kinds of oxides of iron found in almost all soils, viz., the *protoxide* and *peroxide*, and I have not been able to ascertain, from analyses which have hitherto been made of Ceylon soils the relative proportion of each of these two salts of iron. But this is a very important matter for the tea planter to know, as soils which contain the protoxide, even to a very small extent, soon become barren, unless heavily manured. In soils formed from the decomposition of *syenite* and *hornblendic* gneiss, protoxide of iron may be found to predominate, some kinds ot hornblende containing as much as 22 per cent of it, along with salts of *manganese*.

On examining the gneiss of the Totapela, Nuwara Eliya, Kandapola, and Udapussellawa ranges downwards to the centre of the Uva basin, this series of rocks is found to vary from a compact *granitic* and highly-crystalline nature to laminated hornblende and chlorite schists, graduating into fine white sandstone of the consistency of a Newcastle grindstone, then into loose unindurated sandstone. These form the soil of a certain portion of the undulating hills, whilst a great many are formed entirely of purely *subaqueous* deposits, varying from 50 ft. to 100 ft. in depth.

During the late unprecedented rains some enormous landslips have occurred in this district, carrying away, in one instance, the whole side of a hill, about 500 feet in height, revealing at once the formations of untold ages. Here

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I have discovered a set of perfectly stratified sandstone rocks, from 80 feet to 100 feet in thickness, and about 200 hundred feet beneath the surface of the adjoining hills, imbedding large round water-worn *boulders* 1 cwt. to over a ton in weight. They appear to be a red sandstone formation, but in the absence of a single *fossil* it is impossible for me to say to what series they may belong.

It has been asserted by some writers on the geology of Ceylon that none of the stratified formations, *posterior* to gneiss, had ever been found, and that probably they never would. If this were the case, we should be obliged to suppose that during the periods of the accumulation of those formations in other parts of the globe, this island must either have been dry land or that it was not in existence, or existing only beneath the waves. From the very fact, however, of the existence of plumbago alone, such could *not* have been the case, and we are thus led to assume that Ceylon, as an island or part of a continent, must have been more than once submerged and upheaved, and, if plumbago had at one time existed as coal, as Sir Charles Lyell imagines, the last general upheaval must have taken place subsequent to the carboniferous period.

It is also a remarkable coincidence that whatever may be the circumstances under which plumbago is met with in other parts of the island, in Uva it is found amongst the *detritus* of decomposed trap rock. It was also in the neighbourhood of these igneous rocks, where I met with the marble and clay iron-stone.

With the exception of gold, all these minerals are, in England, associated with a coal field, and I am of opinion that if coal be found to exist in Ceylon, it will, most likely, be met with in the hollows and basins of the trap hills of Uva.—R.—Local "Times."

THE GEOLOGY OF MADURA AND TINNEVELLY.

From an article in the *Madras Mail* reviewing a paper by Mr. Foote of the Geological Department, we take a very interesting extract referring to the formation of Adam's or Rama's Bridge between Ceylon and India, and the curious banks of red sand so conspicuous in parts of the Madras Presidency and also in Travancore:—

The chief geological interest, of course, lies outside of the gneissic area on the strip of country, reaching from the coast line for a varying distance inland, which is occupied by the more recent rocks. This area is chiefly covered with gritty sandstones belonging to the Cuddalore beds, lateritic conglomerates and alluvium, but it also contains several small sub-recent marine beds of limestones and grits, which are given in the table as "upraised coal reefs," but this, we fancy, must be a misprint for "coral reefs." Perhaps the most interesting of these upraised coral reefs is one which forms a striking feature of the north coast of the island of Rameswaram and apparently extends from Pamban to Ariangundu as a narrow strip, and then widens out to the north-eastward to form the northern lobe of the island. This northern lobe seems to owe its existence entirely to the upraising of the coral, which is here covered by only a thin coating of alluvium. At present the reef rises above the water-level for at least ten feet, thus showing a considerable upheaval of this part of the coast in comparatively recent times. This is a circumstance which ought not to be lost sight of by the promoters of the scheme for cutting a ship canal across Rameswaram, a scheme which Mr. Foote unceremoniously speaks of as "wild." There is no means of determining exactly when the upheaval took place, but as Mr. Foote suggests, it seems probable that it was this upheaval which gave rise to the formation of "Adam's Bridge," which according to local tradition, once joined the island of Rameswaram to *terra firma* on both sides, and was breached about A.D. 1480 by a tremendous storm. When we consider that plutonic agencies do not seem to be quite quiescent even yet on

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this coast, it appears by no means improbable that Adam's Bridge or Rama's Bridge, as the Hindus call it, was formed suddenly by the action of subterraneous forces, and the mythical tales regarding its formation by an army of monkeys are easily explained. So too is its subsequent destruction by a storm, which was facilitated by the system of jointing which crosses the barrier nearly at right angles.

A very marked feature of the surface geology of the southern districts is produced by the so-called "Æolian Formations," consisting of blown sands, 'teris,' and coast dunes. Of these the teris are the most important, and hitherto there has been some difficulty in explaining fully the mode of their formation. The solution of the difficulty offered by Mr. Foote is very simple, but quite satisfactory. During the prevalence of the South-West monsoon heavy gales blow almost continuously for months together. By these gales great clouds of red dust are swept up from the broad belt of loam which skirts the eastern base of the Ghats, and are carried along eastward till they meet the sea breezes near the coast. The North-East monsoon would of course tend to neutralize this action, but it is usually far less violent than the South-West one, and is accompanied by heavy showers which tend to fix and consolidate the blown sand. In fact the action is similar to what we see going on, on the south side of the Madras harbour, where, in spite of the counteracting influence of the North-East monsoon, the sand is being steadily heaped up against the breakwater. Some of the geological changes produced by these teris are very important. Thus Mr. Foote points out that there are several fresh water lakes in South-east Tinnevelly which have been formed solely by the damming back of the local surface drainage by these hills of red sand. The most important of these is the Taruvai lake, which is surrounded by these teris on three sides, and is really a natural lake, though entered in the district maps as a tank with an artificial bund. The view across this lake which in wet seasons forms a fine sheet of perfectly fresh water, is described as a very remarkable one, and possibly unique, the pure and intense red of the foreground forming a bold contrast with the green of the mid-distance, and the varying blue tints of the background and sky. Another important feature of the teris is the way in which they absorb almost all the rain that falls upon them and give it out in springs near their base, where it is collected and used for irrigating fields. On the other hand the advance of the teris has often done considerable damage by burying fields and gardens, and, in some cases, even houses. The rate of advance of the sands on the Ishamoli teri between 1808 and 1868 was on an average seventeen yards per annum, but they are now moving much less rapidly, and in the four years from 1869 to 1874 the advance was only twenty-four yards. Much has been done here, as in France, to stop the movement of the sand by the extensive planting of trees, and there is every reason to believe that they will in time be all changed into fairly fertile soils.

The consideration of the economic geology of Madura and Tinnevelly takes up a very short chapter in the memoir. The only metal found is iron, and that not of the best quality. At one time it was worked to a considerable extent in the Pudukotah State, but the scarcity of wood at the present time has entirely stopped this industry. Building stone and limestone of excellent quality are found in many parts of the districts. For the former both laterite and gneiss are used. In the Shenkarai and Shakkotai tracts laterite of a very fine quality is obtained in blocks which reach the large size of 8 feet by 1½ feet by 1 foot. Some of the gneiss in the district are easily quarried and yield handsome stones capable of taking good polish, which would, in Mr. Foote's opinion, render them equal in beauty to the finest Peterhead granite. The crystalline limestone of Pantalagudi, Tirumal, and Shenkkotai would yield an inexhaustible supply of beautiful pale grey, grey and pink, pink, and pink and green varieties of marble of high quality, but at present they are used only as rough stones. The memoir is accompanied by a well-executed geological map, on a scale of four miles to

an inch, which ought to prove a very useful companion to any one who has to travel through these districts.

PEARLS owe their lustre to their being composed of fine layers which allow light to pass through them, whilst the numerous layers, lying one under the other, disperse and reflect the light in such a manner that it returns and mixes with that which is directly thrown back from the outer surface.—*Progress.*

MINERALS IN BURMA.—From the last Administration Report we learn that 115 tons of coal were extracted during the past official year from the mine in the Okpho township of the Henzada distritct. There are 28 tin mines and 1 lead mine in the Mergui district, but no information is given of their annual produce. In the Karen hills sub-division of the Toungoo district two mines, producing lead, silver and plumbago, are worked by Messrs. Darwood and Walker. These have only been lately opened, and the outturn, so far, is said to be about fifty tons. No information regarding the galena extracted from Mr. Law's mine at Teetawlay in the Salween disirict is given in the Report. The stream near Shoaygyeem, where the sand used to be occasionally washed for gold, is said not to be worked now.—*Rangoon Gazette.*

GOLD IN NORTH BORNEO.—The communication which Mr. Gibbon has favoured us with (p. 303) is not only interesting but exciting. In the case of ordinary granite, far less than one ounce of gold to a ton of rock pays well, and the North Borneo assay shows the existence in iron dust, which must surely be more tractable than granite, of over an ounce of gold to the ton in Nos. 2 and 4. Such being the case, we suspect the publication of the assay will attract not merely Chinese but European diggers from Australia in any case and probably from Europe itself. At this moment the world is far more in want of gold than of tin, and, whatever the amount of iron dust or alluvial matter required to be turned over, we should think that gold worth £3 12s an ounce, at the rate of even half an ounce to the ton, would pay amply: better, we should think, than the stanniferous ore which is now found so abundantly, not only in "Perak" which owes its name to the silver-like metal, but in Tasmania and many parts of Australia. Hundreds of millions of ounces of gold might now be thrown into the markets of the world without appreciably affecting the price of the metal (the great medium of the world's exchanges) or the profits of the diggers. Mr. Gibbon can no doubt supply information as to the area or areas over which the auriferous sand is spread, to those who determine to go "prospecting" from Ceylon, to take up and work claims and collect rich dust if not nuggets.

PEARL FISHERIES OF PEARL.—The pearl fisheries appear to be in a languishing condition. Formerly a very large source of revenue, they are at the present day probable not worth to the Government more than 50,000 tomâns or £16,000 per annum. The pearl beds are formed by the chief men of the adjacent towns, and, instead of being distributed in Persia, are for the most part sent to Europe by the steamers plying to the Persian Gulf. The reason for the present condition of the Persian pearl beds is that they have been allowed no rest, but have been constantly worked. In Ceylon, the pearl oysters are allowed a rest for intervals of two years, during which they are allowed to mature. Mr. Benjamin says there is reason to believe, however, that the beds at the island of Karâk, near Bushire, which have not been worked for some time, are now in a condition to repay capital expended there, especially if diving is extended to a depth of fifty to sixty fathoms. As the ordinary depth reached by pearl divers is rather less than this, the Persian Government have recently sent to England for diving dresses of the latest invention, and an experienced diver has been engaged at a high salary. With the assistance of these, it is expected that the pearl fisheries of Persia will regain their former importance.—*Journal of the Society of Arts.*

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GOLD IN NORTH BORNEO.

27th February 1885.

DEAR SIR,—The accompanying memo. and certificate of assay may be interesting to your readers.

The information contained in the memo. may be relied on, as it is compiled from materials placed at my disposal by the Secretary to the Board of Directors of the British North Borneo Company.—Yours truly,

W. D. GIBBON.

Memo. British North Borneo.

Kandy, 27th Feb. 1885.

The certificate of Assay signed by Messrs. Johnson, Matthey & Co. (copy of which accompanies this) confirms the existence of gold in the Segama, and since then a find has been reported in the Kinabatangan. There is thus every reason to think an alluvial deposit will be found to exist extensively over a very large area.

The black metallic sand which the Chief Commissioner of Lands, Mr. Walker, always found in conjunction with the gold dust, is an iron sand similar to what is found and smelted in New Zealand. For iron it is of no commercial value in Borneo at present, but it is interesting to know, that, if found in large quantities, it will be very valuable, for the specimens sent to England gave a result of 1¼ to 1½ oz. of gold to the ton.

The No. 1 specimen of gold washed in Sungei Bilang is of very good quality and estimated to be worth 72s per oz. The fifth specimen on the list marked A. rock is the sample which Mr. Davies brought from the Paitan Sugar reported in Governor Treacher's dispatch of the 30th October. This also contains gold to the extent of 3 dwt. to the ton.

The crystals sent home with the gold were so like diamond, that even the lapidary was deceived till he tested them and found them to be quartz.

Messrs. Johnson, Matthey & Co. confirm Mr. Walker's opinion that better results will probably be obtained when the dry season will admit of working the old gravel deposits.

These gentlemen are sanguine about the mineral prospects of North Borneo territory, and anticipate that valuable discoveries will be made as the country is developed.

The Directors of the Company trust that this report of the Assayists will lead to the Chinese taking up gold washing as they do in other parts of Borneo.

W. D. GIBBON.

Certificate of Assay.

The British North Borneo Company,

Hatton Gardens, E.C., 5th Feb. 1885.

For British North Borneo Company.

We have examined the samples of mineral marked as under and find the following to be the result:—

No. 1.—Gold washed at Sungei Bilang, Segama River, Quality gold ·889, silver ·080.

No. 2.—Ore washed by Mr. Sachse for trial for tin. Produce of gold 1·500 oz. per ton of 20 cwt. of ore—no tin.

No. 3.—Ores S. Bilang, Segama. Produce of gold ·650 oz. per ton of 20 cwt. of ore—no tin.

No. 4.—Ore fused in a crucible portion of black dust from Sungei Bilang. Produce of gold 1·150 oz. per ton of 20 cwt. of ore.

A.—Rock. Produce of gold 0·150 oz. per ton of 20 cwt. of ore.

(Signed) JOHNSON, MATTHEY & Co.

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CHANKS AS ALLEGED DESTROYERS OF PEARL SHELLS.

The following article, interesting to us in Ceylon, is from the *Pioneer*:—

Mr. Thomas, the veteran fisherman of the Madras Presidency, has recently been investigating the pearl fisheries of Tuticorin with a view to their future improvement. His report will no doubt be read by all lovers of the pearl, nor would it be difficult to interest the ladies of India on behalf of the oyster in which it is embedded. Mr. Thomas, however, has acted with doubtful wisdom in attempting to vindicate the "chank" from the charge of enmity to the pearl-oyster which has long been brought against him. The "chank" (*Turbinella pyreem*) it may be stated is another shell-fish which is often found near oyster-beds and is regularly fished on account of its beautiful shell. He is strongly suspected of eating the pearl-oyster, and so strong indeed is the suspicion that the Secretary of State once ordered his extermination. This terrible decision has not been thoroughly carried out, and the poor "chank" has at last happily found so able an advocate as Mr. Thomas to say a good word for him. The evidence against him is partly circumstantial and partly as to identity, and it is no doubt exceedingly damaging to the general character of the "chank." In a foxhunting country vermin are every day killed on much less proof. In the first place the "chank" is carnivorous. There is no doubt as to this; his teeth betray him. In the second place the "chank" has a near cousin, "the elephant chank," who has been found in such a position relatively to a dead oyster as to make the conclusion that this relativity was the cause of the oyster's demise unavoidable. If a shell-fish is found curled round the corpse of another, and the shell of the corpse is perforated in a vital part, and the perforation could have been caused by the lancet tongue of the circumjacent mollusc, any jury would give a verdict of "wilful murder" against the latter. And such is the case against the "elephant chank." That the chank common should suffer from the character of his elephant cousin is not surprising. But more than this, there is evidence that the chank common has been caught in the act of eating an oyster. This shows that he has no moral objection to oyster-murder, and the only question is whether he is in a position to commit it. Mr. Thomas argues that the "chank" common is without the lance tongue necessary to perforate the oyster. He cannot get at the delicacy while it lives, and must wait till it opens in the act of death. He is the jackal or the ghoul of the pearl-oyster bed, but not the murderer of living oysters. Furthermore, Mr. Thomas urges that the oyster's home is the rock and the chank's home the adjoining sand: that the chank rarely ever leaves his home, and that the pearl-oyster need be in no dread as long as he sticks to his own quarters. But Mr. Thomas' vindication of the "chank" is by no means satisfactory, as the admissions he has to make in the course of the defence are extremely damaging to his client's reputaion. Were we on our trial for homicide, we should prefer the mercy of the Judge to the advocacy of the First Member of the Madras Revenue Board.

NORTH BORNEO (NEW CEYLON) AND THE DISCOVERY OF GOLD.

Kandy, 8th April 1885.

DEAR SIR,—As some of your readers have written to me for information regarding gold in Borneo, after persuing my memorandum on that precious metal, which you were good enough to publish in your paper, I trust you will not think I am trespassing on your good nature in asking you to publish such of the information I now send you as you think desirable.

You will be glad to learn that our old friends Messrs. Von Donop and Callaghan are once more in New Ceylon, the one acting as Private Secretary to Governor Treacher, and the other Assistant to the Colonial Secretary, Mr. Malcolm Brown.—Yours truly,

W. D. GIBBON.

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(*Extract from* "*North Borneo Herald*," *dated* 31*st Dec.*, *from article entitled* "1884.")

In the way of minerals the event of the year has been the verification of the reports of the existence of gold in the Segama river district. On the last day of October, Mr. H. Walker, Commissioner of Lands, started on an expedition in the river with some Sarawak Malays who had brought in a small quantity of gold to Sandakan. He was only three days on the field, but reports that he searched at thirty or forty different places from near its mouth (the Bilang river, a tributary of the Segama) "to a point two or three miles up the river and found gold at nearly every trial, generally in small distinct specks, large enough to gather with the fingers, sometimes larger, river worn gold, and always in conjunction with a black metallic dust and iron or copper pyrites. The rocks met with were granite, gneiss, quartz, felspar, basaltic limestone, jaspar, porphyries, red sandstone." We quote from Mr. Walker's report which is before us. It happened most fortunately that H. M. S. "Pegasus" was in harbour when Mr. Walker returned to Sandakan, and advantage was taken of the presence on board her of the Reverend Father Julian Tennison Woods, who has frequently been deputed by the Australian Governments to make reports on geological matters, and the following opinion was given by him:—"No. 1 shotty alluvial gold with very little silver, apparently derived from alluvial deposits, and should say if the proper leads were discovered would be very rich; I should recommend trying beds of shallow rivers and small streams. No. 2 seems to contain a fair proportion of tin ore; would recommend a trial smelting."

The advent of the N. E. monsoon with rain and heavy weather on the bar precludes further operation for the next one or two months, often which doubtless the investigations will be resumed, and, should tin, as well as gold prove to be in quantity, we shall have a very different report to make on the country's progress this day twelve months.

Nothing whatever is yet known as to the terms on which the Company will allow these minerals to be worked; whether they will keep them in their own hands, lease them to a European or Chinese Company, or allow individual Chinese and Malay miners to work on the field, as in Sarawak.

It appears to us, that if the fields prove sufficiently rich, the Government could not do better than adopt, with necessary modifications, the Queensland Gold Fields Act of of 1884, and the Mineral Lands act of 1882, in force in the same colony, which are fully described in Mr. C. S. Dickson's paper on "The Mineral Wealth of Queensland" read before the Royal Colonial Institute in March last.

One thing is certain, we think, and that is, that the probabilities are that the mineral wealth of this country will be best developed by Chinese labour and even by Chinese capital. The experience of the protected Malay States as regards tin tends to prove, so far at least, that, where Chinese companies can make fortunes, European companies may prove complete failures. For the ordinary Australian digger there is no field here—the tropical climate with its consequent fever, when much exposure to sun and weather has to be borne, is altogether against him, and this should be thoroughly understood. It is melancholy to reflect that the late Mr. Frank Hatton was on the eve of discovering the Segama gold fields when he met his death by accident on the banks of that river.

On the West Coast, at Bauguey, chromium, copper and arsenic have been found; in the neighbourhood of Tamboyukam, near Kinabalu, a silver ore and pyrites; a sample of native copper brought in by the late Mr. Witti is now in the London Office and it is said also to exist in the Paugalau river district a branch of the Padas. A rich sample of galena and silver, yielding on assay 115 ounces of silver to the ton, has been picked up by a native near Mumpakul, now in our territory, and a similar sample has been seen at Suyam Lawass, also in our territory, the natives averring that quantities can be obtained up

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the Bukaw river. Samples of plumbago were years ago brought by natives to Labuan, but it is not remembered from what district, though Putatau is supposed to have been its source.

The minerals ascertained to exist in Northern Borneo are gold, silver, copper, chromium, tin, plumbago, lead and coal. Antimony and cinnabar are reported. What is now wanted is, a thorough examination of the known mineral districts by a practical geologist. Mr. A. H. Everett has an agreement with the Company authorising him to prospect a certain portion of the territory and perhaps no better man could be found for the work, but his time is not at his disposal and his own Provisional Brunei Mining Association has the first claim on him. If only the Company could engage the services for six months, during the dry season, of a gentleman with the experience of Mr. Robert Jack, the Queensland Government Geologist, all doubts would quickly be set at rest, and we should then at last be able probably to say the final word on North Borneo minerals. Is it beyond the bounds of possibility that the Queensland Government should consent and Mr Jack be willing to lend us his services for a short period? The matter is one of great importance to the country for, as has been said with regard to Australia—what was South Australia but in a state of insolvency before the discovery of copper?—what was Victoria before the development of the gold fields? What was New South Wales even before gold era? How wonderfully these colonies have been awakened under the influence of such discoveries. The mining question is of the utmost importance. Mines develop commerce; they bring population and a demand for farms; they originate towns with all the high civilization attending them.

IN SEARCH OF GOLD.

(*Extract from Report in "North Borneo Herald" of the 31st December by Mr. Henry Walker.*)

"Gold has been found" was the news I received one morning last October when I arrived at the offices in Elopura. It appeared that a party of Sarawak traders, five in number, had returned from the river Segama and had brought a sample of gold. There was not much, but it appealed to the imagination. It was gold, and the excitement grew while future possibilities were suggested. The result was that I was requested to visit the place in company with the Sarawak traders aud verify their discovery. They had been assisted therein by a headman on the river who had shown them where to work, but it was Mr. Pryer, the Resident, who first suggested to them to visit the river and discover whether gold existed or not—the inducement being the Government reward of $500 on the discovery of a mineral, one hundred of which is due on discovery and four hundred when the mineral is worked. Their first visit was in February, but the rains prevented them working in the river bed; they returned in July and obtained the sample brought on 11th November. There is little chance of getting gold if the water does not fall. The Sungei Bilang is sixty feet wide: the jungle nearly meets overhead, sometimes does, and without the sun it is a gloomy spot. The Sarawak men are in the hut they made before, which only required new kajangs. They are now putting handles to their tools. My men are busy on their own huts, or on mine which is to be nine feet by six.

The water is very cold, and it was 10 o'clock before the men got to work. They said it was impossible to work at the old spot, there was too much water; so they tried up the stream on a bed of single. They removed the big stones collecting any grit that adhere to them, which they say is often rich in gold, and the top stones once away they collected everything and placed it in their pans—large wooden dishes, thirty inches in diameter with a pit in the centre, very good for the purpose. The result of every pan was a small quantity of

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black dust, which I am preserving, and almost always in the black gleamed a speck of gold. Where does it come from? One piece is of appreciable size, as large as a grain of rice, but thin and water-worn. There were five men washing, and each was equally successful in finding gold, not in dust, but in small pieces. They washed for two hours, and I was glad they gave up as I could see they were very cold.

I went up the Segama this afternoon to see if there were any hills, and came across limestone on the true left bank, but nothing further of note. Searching for orchids I raised a little mouse-deer, which scuttled away from its lair at the root of a big tree. This is first game I have seen. The wet weather renders it unnecessary for game to come to the river to drink, and my men say a flooded river frightens game away. We have seen nothing but a few alligators and the one rhinoceros mentioned 12th November. We went up the Sungei Bilang: unfortunately it rained a good deal in the night and the river is pretty full, too much so for midstream working, and we have to content ourselves with working the sides. The stuff is too new for any good results. Still at each place we found gold in specks, brilliantly discernable against the black metal accompanying it. No dust--where does that go? A fine day and pleasant working: we did not get back till 4 o'clock, very tired. The jungle is full of a tree, called Ankaug, whose nut yields oil and which the Resident asked me to look for. The oil used in place of coconut oil and is much more valuable. I have given orders to collect a quantity. On the right bank of the Sungei Bilang I saw a tree called Tappang by the Sarawak men, a bee tree, ten feet in diameter at twenty feet above the ground. I believe this would be a big tree in any part of the world. The timber on this river, Segama, runs very large and increases in size as we progress inland.

13th Nov.—The river is much lower and the men set to work near their old spot, and found gold again. They say the river was lower on the former occasion, which I can well imagine as when they stoop to fill the scoop with dirt they buried their shoulders in water. I got my specimens of stone together: they include water-worn granite, like grey Aberdeen, gneiss, slate, crystalline sandstones, jasper, porphyries, serpentine basaltic limestone (water-worn), and coral limestone. As I write their names I cannot help speculating on the possibilities of the future.

14th Nov.—Got away early and found the river fuller than when we came up. At the big fall, Tabauat, we got out to lighten the boats, but did not remove the baggage. Going down the falls was exciting work at first, but there are so many of them they are becoming less so; besides which, as we progress, the waters are becoming quieter. The country we have passed through has been fairly flat, much occupied by natives in days gone by. I feel thankful we started, and that we have had a fine day as we could hardly have come down safely in the rain. As it was we had some narrow escapes, and, had the rock-ripples been hidden by falling rain, we should probably have come to grief. I stopped a few times to chip off a bit of rock and pick up bits from the single.

15th November.—The 16th day. We left at 6-45 p.m. Last night we had a little rain, but nothing that would account for the rising of the river which rose rapidly from the time of pitching our camps until this morning. In the night time I heard the men shouting, and on inquiry found they were moving higher up the bank, and this morning I was awoke by the noise of a falling tree and cries. A dead tree had fallen across one of the huts striking Nacoda Budjang, the head of the Sarawak traders, on the the back of the neck. He was sitting up smoking a cigarette, waiting for daylight, when the tree fell. The day was just breaking, and after a little I was able to examine him, and was glad to find no bones broken, but he was almost insensible, I could do nothing beyond giving him my pillow and seeing him laid in the boat as carefully as possible. Immediately after starting we entered a gorge. Hills on both sides for about seven miles—not high, perhaps 200 feet above the river

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but tolerably steep, and sandstone rock appeared on the bank. If the future road has to follow the river this portion will be expensive. At the limestone caves I stopped and examined the face of the rock carefully for fossils. To my delight I recognized a coral similar in appearance to one now existing in these waters, but in attempting to break it off I was unsuccessful. I however obtained some pieces with well marked fossils and had to be content. The face of the cliff looked particularly white and bold today, so different from the Gomauton hill which might be taken for sandstone from its colour. This rock resembles white marble, at a little distance. At the Dusuns' campong we stopped to pay Palar and Uli for coming with us. Paid them in fish and salt. The old men left by Gomba in charge of his big boat (and its contents) had done very well and had a lot of beeswax in nicely made-up cakes. So had the man in charge of my heavy boat further down, at Shabauda Pungut's. He had filled the lower part of the boat with rattan cane. What he gave for them I did not learn, but I dare say the result will be profitable to old Gomba.

For three dry fish (perhaps 3 lb.) we got 50 lb. of sweet potatoes! Barter is at times very profitable. I learn that at Palawan one of our traders gives a box of sardines (price 12 cents) for two bundles of rattans. These latter sell in Elopura 50 cents to $1 per bundle according to demand and quality. Sardines are eaten, like caviare, as a relish, and one box would last some time, but even allowing for that, the price paid is enormous. Truly these people remind one of the old Romans and their predilection for English oysters regardless of cost! They resemble them in other respects too—the toga, the short cropped hair, a fillet of cloth around the head, perhaps with a flower stuck in it, the short sword at the waist and above all in their grandly independent character.

16th November.—17th day. We stayed last night at Shabunda Pungut's campong. I had to give up my small boat to its owner and pay him for the loan in salt, fish, &c., and remove into the large boat. We left this morning at 6-30 and floated rapidly down to Pangeran Kahar's campong. The launch had left on the 9th. We only remained as long as courtesy demanded and resumed our journey. Still fine, and I am half-inclined to regret I did not stay a fourth day at Sungei Bilang; besides our progress has been so rapid that we shall arrive at the mouth before the launch can meet us.

I stopped at the Batu Tatak, where gold is said to have been found, and examined the rock. Sandstone at first sight, but appearing above it is a vein of granitic gneiss with chlorite attached. I got a sample, but found the rock very hard to break.

17th November.—18th day. Last night we stayed at the Gold rock. I got specimens—*micaceous schist*—one a gold red the other grey. A very appropriate name from the appearance of the rock, but I am told that gold is never found near this class of rock. We are 81 miles from the mouth; the river is tidal so far, and the depth is over three fathoms.

THE PEARL FISHERIES OF TAHITI.

A recent issue of the *Journal Officiel* contains a lengthy report by M. Bouchon-Brandely, Secretary of the College of France, who was sent by the Ministry of Marine and the Colonies on a mission to Tahiti to study questions relating to oyster-culture there. The principal product of what M. Brandely, with "the summer isles of Eden" fresh in his mind, calls "*notre belle et si poetique colonie de Taiti*," is mother-of-pearl. All its trade is due solely to this article, which for a century has regularly attracted vessels to the islands which compose the archipelagoes of Tuamotu, Gambier, and Tubuai. The mother-of-pearl which is employed in industry, and especially in French industry, is furnished by various kinds of shells, the most estimated, variegated, and beautiful of which are those of the pearl oyster. There are two kinds of pearl oysters—

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one, known under the name of pintadine (*Meleagrina margaretifera*), is found in China, India, the Red Sea, the Comoro islands, North-Eastern Australia, the Gulf of Mexico, and especially in the Tuamotu and Gambier archipelagoes; the other, more commonly called the pearl oyster (*Meleagrina radiata*), comes from India, the China seas, the Antilles, the Red Sea, and Northern Australia. The shell of the former is harder, more tinted, more transparent, and reaches greater dimensions than the latter. Some have been found which have measured thirty centimetres in diameter and weighed more than ten kilogrammes, while the *Meleagrina radiata* rarely exceeds ten centimetres at the most, and never weighs as much as 150 grammes. Both varieties supply pearls, those of one kind being at one time more favoured, at another time those of the other. This depends on fashion; but, on the whole, those found in the great pintadine are more beautiful, and the colour more transparent, than those of its congener. The amount of the trade from Tahiti in pearls cannot be stated with accuracy, as there is much clandestine traffic, but M. Brandely puts it down approximately at 300,000 francs, England, Germany, and the United States being the chief markets for the fine pearls. The great pintadine is found in great abundance in the Tuamotu and Gambier islands. The situation there is very favourable to them; in the clear and limpid waters of the lagoons they have full freedom for development, and are undisturbed by storms. Mother-of-pearl is found in almost every one of the eighty islands which form the archipelagoes Tuamotu and Gambier. These belong to France, having been annexed at the same time as Tahiti and Moorea, and have a population of about 5,000 people, all belonging to the Maori race. M. Brandely gives an interesting description of these little-known islands and people. The latter appear to hover always on the brink of starvation, as the islands, which are composed mainly of coral-sand, produce hardly anything of a vegetable nature. While the neighbouring Society islanders have everything without labour and in abundance, the unfortunate inhabitant of Tuamotu is forced to support existence with coconuts, almost the only fruit-trees which will grow on the sandy beach, with fish and shell-fish which are poisonous for several months of the year, and often they have to kill their dogs for want of other animal food. There are no birds, except the usual sea-birds; no quadrupeds, except those brought by man; no food resources necessary to European life, except what is brought by ships. Although the people are gentle and hospitable, they practise cannibalism, and M. Brandely suggests that it is pitiless hunger alone which has driven them into this horrible custom. These miserable people are the chief pearl divers of the Pacific; indeed it is their only industry, and women and even children take part in it. There is at Anaa, says the writer, a woman who will go down twenty-five fathoms, and remain under water for three minutes. Nor was she an exception. The dangers of the work are great, for the depths of the lagoons are infested by sharks, against which the divers, being unable to escape, are forced to wage battle, in which life is the stake. No year passes without some disaster from sharks, and when one happens, all the divers are seized with terror, and the fishing is stopped for a time. But gradually the imperious wants of life drive them back to the sea again, for mother-of-pearl is the current coin of the Tuamotu. With it he buys the rags which cover him, the little bread and flour which complete his food, and alcohol, "that fatal present of civilization," for which he exhibits a pronounced passion. Twenty or thirty years ago the trade in mother-of-pearl in the Tuamotu archipelago was very profitable for those engaged in it. For a valueless piece of cloth, a few handfuls of flour, or some rum, the trader got half a ton of mother-of-pearl worth one or two thousand francs, or even fine pearls of which the natives did not know the value. The archipelagoes were frequented by vessels of all nationalities: mother-of-pearl was abundant, and pearls were less rare than they are now. The number of trading ships increased; there was competition amongst them,

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and consequently a higher price to the natives, who fished to meet the new demand with improvident ardour. The consequence is that the lagoons are less productive, and that even the most fertile give manifest signs of exhaustion. The prospect of having the inhabitants of Tuamotu thrown on its hands in a state of helpless destitution, as well as of the disappearance of the principal article of the trade of Tahiti, and an important source of revenue to the colony, alarmed the Colonial administration and the Ministry of Marine and the Colonies in Paris. Accordingly, M. Brandely was selected to study the whole subject on the spot. The points to which he was instructed to direct special attention were these: (1) The actual state of the lagoons which produce oysters: are they beginning to be impoverished, and if so what is the cause, and what the remedy? (2) Would it be possible to create at Tuamotu, Gambier, Tahiti and Moorea, for the cultivation of mother-of pearl, an industry analogous to that existing in France for edible oysters? Would it be possible by this means to supply the natives of Tuamotu with continuous, fixed, remunerative labour which could render them independent, and remove them from the shameless cupiditiy of the traders? Could they not be spared the hardships and dangers resulting from the continued practice of diving, and be turned to more fixed sedentary modes of life, by which they might be raised gradually in the social scale? (3) Should the pearl fishing in the archipelagoes be regulated, and, if so, what should be the the bases of such regulations? It was on the mixed economical and philanthropic mission here indicated that M. Brandely went to Tahiti in February last. The statistics did not show any decline in the production of mother-of-pearl, but a careful study on the spot showed that this was due to the great amount of the clandestine traffic, and that the lagoons were growing less productive day by day, that beautiful mother-of-pearl was becoming rarer, and in order now-a-days to get oysters of a marketable size, the divers are forced to go to ever greater depths. M. Brandely recommends prompt and vigorous measures be taken at once, as the lagoons of Tuamotu will soon be ruined for ever. The partial steps already adopted have been useless. The total prohibition of fishing in some of the islands for several years has failed, because it has been found that the pintadine is hermaphrodite, and not, as formerly was believed, unisexual. The cause of the impoverishment of the lagoons is excessive fishing, and nothing else. He thinks that it is possible to create in Tuamotu, Gambier, Tahiti and Moorea a rational and methodical cultivation of mother-of-pearl oysters, analogous to that existing with regard to edible oysters on the French coasts, and to constitute for the profit of the colony an industrial monopoly which no other conntry can dispute, for nowhere else can such favourable conditions be met with.—*Nature.*

METALLIC VEINS IN THE ROCKS OF CEYLON.

SIR,—There has been much learned speculation about the age of the rocks in Ceylon, but it seems to me of very little importance what place they occupy seeing that they are old and crystalline enough to make it highly probable that they contain something of more value than fossils. I mean metallic veins, the search for which seems to me to have been sadly neglected, for it is hardly possible that rocks so crystalline could prevail over such a large extent of country and not have some payable fissures in them. I have only heard of one case where any real prospecting was done, and, I believe, some silver found, but the work was not carried out sufficiently to prove whether the vein was a paying one or not. Some good, however, was done by the attempt as it showed that veins may be looked to run from about E. N. E to W. S. W., same as they do in Wales.

Many erratic attempts have been made to find gold in *bedded* quartz when the strata chanced to be sufficiently on edge to give it the appearance of a fissure vein; but nothing was examined that did not show quartz, as only gold

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was hoped for. The only reason I have heard, given against the chance of finding metals in Ceylon, is that no trace, may be said, is to be found of them on the surface; but this is hardly any reason, in my opinion, against them in a country that has not been knocked about by earthquakes and volcanic disturbances. Except silver, very few metals are to be found quite up at the surface, and copper is usually from 80 to 100 feet down. M.

[Our correspondent, in a private note, tells of "prospecting" in Pussellawa, and sends the following from Mr. A. Dixon:—

"Normal School, Colombo, 13th August 1884.

"I am sorry I have kept you waiting so long, but have been very ill under the doctor, who would not allow me to do any work. I have assayed your quartz. It is of a far superior quality to the last you sent, being much more compact. It contains the minerals hornblende and epidote in layers, and at the junction of these with the quartz there is metal. Silver is present at the rate of 113·5 dwt. per ton. There are also traces of gold, tittanium, iron and manganese, and other less important metals.—Yours sincerely,

ALEXANDER C. DIXON."

We quite agree with our correspondent that a thorough geological and mineralogical survey of our formations should be made. There have been some pretty deep cuttings on our mountain railways, and an examination of the débris might reveal something valuable. Mr. Blackett, who brought knowledge and testing material from Ballarat, is sanguine that gold will be found in Dolosbage. Mr. Blackett, in fact, had specimens of his rock assayed at the School Mines, Victoria, with the result of gold being found at a rate which would pay under favourable circumstances.—ED.]

MINERALS IN CEYLON.

DEAR SIR,—Like the man who felt inclined to kick the postman because the letters he brought were all duns, I suppose I ought to pitch into you for causing my "platinum" turn out only "iron pyrites." "O what learning is!" as Juliet's nurse exclaimed. Metallurgy and mineralogy are sealed books to me, but I judge it was not silver from its being too hard and not white enough. I therefore oscilated between "tin" and "platinum"; and as, in human nature, "the wish is father to the thought," I chose the latter. Boo, hoo! Will you kindly supplement your information with a little further instruction, and inform me briefly *how* sulphuric acid &c. is made from the pyrites? A course of "Lyell" has since opened my eyes. The metamorphic rock which contains the veins of iron pyrites is the gneiss, soapstone, argillite, schist, or whatever it may be called, and is easily broken up with a jumper. I will send you down some fair office samples for yourself and the Museum, if they have none there.—Yours ungratefully,

PLATINUM.

[A geologist answers the above enquiry as follows:—"Iron pyrites ($Fe S_2$) is a sulphuret or sulphide of iron, consisting of one equivalent of iron and two of sulphur. The metal is oxidised and dissolved by boiling with concentrated nitric acid, the sulphur separating and rising to the surface of the solution in grey flakes and eventually fusing into yellow globules. A portion of the sulphur thus separated becomes oxidised and forms sulphuric acid In making the sulphuric acid of commerce, there may be some simpler method of reducing and utilizing the pyrites. Mr. Cochran would no doubt be able to give you reliable information on the subject being a practical chemist." The position of a country in the ranks of civilization being fixed by its consumption of sulphuric acid, according to a well-known saying, a simple method of manufacturing the article in Ceylon would indeed be advantageous; but we fear this is out of the question, and that the process is complicated and expensive—ED.]

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EXPERIMENTAL CULTIVATION OF PEARL OYSTERS.

Captain Donnan's report is to the following effect:—

"I regret to say that out of 12,000 oysters placed in the experimental tank on the reef off Silavatturai in March last, I found only 21 remaining alive. Some of the oysters may have been washed out of the tank by the S. W. monsoon sea, as it was not completely sheltered from the wash of the waves, but the bulk of them have, I believe, died off and been destroyed by some fish preying upon them. About 100 dead shells were found in the bottom of the tank, many of which bore evidence of having been bored through and nibbled away. It is just possible that some fish may have got into the tank and preyed upon the oysters either by gettiug over the coral barrier around it, which would be slightly under water at high-water, or through the interstices of the coral underneath

"The experiment so far has been a failure, which may be attributable to four causes: 1st, overcrowding the oysters in the tank; 2nd, deficiency of nourishment in water so near the surface; 3rd, destruction by fish which had got into the tank and preyed upon them; 4th, by excessive agitation of the water in the tank during the S. W. monsoon sea; or probably to all these causes combined.

"I shall try the experiment again in March next in a tank to be made on a more sheltered part of the reef, with the embankments raised above water and fewer oysters placed on it."

We are glad to see that Capt. Donnan means to persevere in experiments which, notwithstanding previous failures here and off the coast of Southern India, are, we cannot doubt, destined in the end to be successful. There are many appliances of modern science, such as the electric light which could be applied and which it would pay to apply so as to secure success in the culture of the pearl-bearing bivalve. Besides the reasons for failure adduced by Capt. Donnan, it seems quite possible that the higher temperature of comparatively shallow water may have had an injuriously effect. Unlike the edible oyster, the pearl mussel seems to flourish best in comparatively deep water, from four to seven fathoms. Not only is the sea-water still at such depths, but it is quite possible that many of the predatory fish, which are so destructive to the shells, do not exist at, or but rarely visit, such deep floors of the sea as constitute the habitat of the "pearl oysters." The results of seccessful culture in converting a capricious but welcome source of revenue into constant productiveness would be so important to the clony and all its interests, that we cannot doubt Government will afford Capt. Donnan all possible aid as well as encouragemt in his interesting and inelligent efforts to cultivate the pearl oyster.

THE PEARL FISHERIES IN WESTERN AUSTRALIA.

The *Standard* of Nov. 23rd has an interesting article on the discovery of pearl banks in King Sound, Western Australia. "The locality," it says, "is just the spot in which one would expect the gem-bearing oyster to breed. It is a deep and comparatively quiet inlet of the warm sea which leaves the shores of Western Australia, and therefore in every way suited for a mollusc which loves quietness, and has an insuperable objection to cool currents. The chances are all in favour of the pearl oyster being found in greater or less abundance in the majority of the bays and gulfs around the coast. Nickol Bay has long been a famous 'fishing' station; the oyster abounds in nearly every suitable lagoon of the Pacific Islans; and for many years past the 'fishery' has formed an important industry off the shores of Queensland and North Australia. It is true that neither in size nor in water can the pearls of Torres Strait and Western Australia compare with those of Ceylon, Panama, the West Indies, or the Persian Gulf. Yet the shells within which they grow are much more valuable for the cabinet and button makers than those which yield the finer gems of the Orient

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and Tropical America. Indeed, the Australian and Polynesian pearl oyster is 'fished' not so much for the pearl which they may or may not contain as for the shells. Hence, though the occasional profits of the business may not be so great as those of the industry as pursued in Ceylon, yet the returns are steadier. For, gem or no gem, every oyster brought to the surface represents so much money. There is—as there must always be in any trade pursued under the surface of the sea—a certain gambling element in it. But the risks are infinitely less than those attending the work of men who depend on pearls alone for their reward. Until lately the 'fishers' have, for the most part, confined their operations to the strait between Queensland and New Guinea. They have, however, for some time stretched along the entire extent of coast likely to yield the object they are in search of, and we may be certain that before long we shall hear of fine hauls being made in some of the half-explored or wholly unvisited bays and gulfs of Papua. Hitherto it has only been the extreme risk run by the fishers which has prevented the extension of their operations in that direction. Still, if the necessities of the Colonists demand it, we cannot doubt but that a gun-boat will be sent to protect the divers, just as, at intervals, the Navy has extended protection to the establishments which pursue their calling in the island in Torres Strait, which, for this very reason, we permitted the Queenslanders to annex some six years ago."

Mr. E. W. Streeter, of Holborn Viaduct, writes to our contemporary to say that, being largely interested in the pearling industries of Australia and Ceylon, he has read the article with much attention, and adds:—"The so-called new pearling ground at King's Sound has been known for some tine, but owing to the depth of water there, varying from 15 to 20 fathoms, it could never be worked by naked divers, and it is only lately since apparatus divers have been introduced along the coast that the ground has had a fair chance of being properly tried, and you know with what success; but even now its depth is detrimental to the health of the men and also to the amount of work they can do per day. The Western Australian fisheries, however, have produced pearls which in size and quality can compare with the finest the world has ever seen. One pearl which was found along that coast last Boxing Day by one of our boats was as large and round as an ordinary marble, and for it the present owner has refused over 1,300*l.* We have visited some of the half-explored bays and gulfs in New Guinea, and discovered fine shell there, but the unhealthiness of the climate was found to be a far greater drawback to work than the hostility of the natives. In fact, so many divers died of that peculiar disease known as Beri-Beri that few care to go again. Those engaged in shelling have to undergo many hardships caused by the scarcity of fresh water, the frequency of hurricanes, and the dangers of navigation in close waters, of which only incomplete charts have been made; but though fortunes have never been won at this industry, the better class of shellers have conferred many benefits on the natives belonging to the different coasts where they have worked."—*European Mail.*

PLUMBAGO:—CEYLON'S ONLY MINERAL OF IMPORTANCE.

(*Summary of a Paper read before the Ceylon Branch of the Royal Asiatic Society, on August 28, by Mr. A. M. Ferguson, C. M. G.*)

PLUMBAGO: With Special Reference to the Position Occupied by the Mineral in the Commerce of Ceylon; and the Question Discussed of the Alleged Existence in the Island of the Allied Substance, Anthracite.

Mr. Ferguson commenced by stating that the mineral of which his paper treated was a form of carbon, the substance which constitutes so large a

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portion of organized nature, more especially of the vegetable world. Graphite was in truth vegetable matter mineralized by those various forces of moisture, heat, friction, pressure, and electricity or magnetism, which have so marvellously metamorphosed the primitive rocks in which the mineral is generally, if not exclusively, found. In Geikie's Handbook of Geology, graphite is mentioned first in the list of rock-forming minerals, sulphur and iron following, before silica in its protean forms is specified. In a more or less definitely crystallized, foliated, columnar, needle-like, or massive shape, the mineral embodies the altered remains of some of the earliest plant forms which appeared on the earth, when the fiat was uttered in the far back ages of creation, "Let the earth put forth grass, herb yielding seed, and fruit tree bearing fruit." Those of the audience who entertained a vivid recollection of the fascinating paper by Dr. Trimen on the Flora of Ceylon, recently read in that hall, could imagine the delight it would afford that eminent naturalist and thousands of other scientists, could the brilliant steel-grey to jet-black ore they were considering reveal the secrets of its vegetable origin and show the fibres, the leaves, the flowers, and fruits of the earliest herbage of the morning of the times, from which it has been transformed, in like manner as ordinary coal also generally speaks of the early days of the geologic ages. But graphite (so called from its earliest use in the formation of pencils for writing and sketching), which there can be little doubt is closely allied to coal, although generally older in origin, and the subject of more intense and long-continued metamorphic influence than the carbonaceous substance so valuable as fuel, is too highly mineralized (with the exception, perhaps, of the formations in Canada) to display a trace of the vegetable tissues from which it claims its descent.

To the seeker for fossil remains of ancient organic life, therefore, graphite, like our other primitive rocks, gneiss and crystalline limestone, is less interesting than are the coal measures, with their wonderfully preserved specimens of plants and animals and shells, on which human eye probably never looked until the operations of the toiling miner revealed their, in some cases, almost perfect lineaments. Graphite seems, in truth, to be the most highly crystallized form of carbon next to the peerless diamond, which poetically, if not with perfect scientific accuracy, has been described as a drop of pure liquid carbon crystallized. Graphite (to which, when burnt, the diamond reverts) has a beauty of its own, and as small diamonds have actually been formed by artificial means, the time may possibly arrive when the form of carbon which mineralogists rank only next below the diamond may, by means of the appliances of progressive science, be advanced from the second to the first place. Let us only attempt to imagine a mass of pure graphite equal to a quarter of a ton, such as that sent to Melbourne in 1880, and the still larger mass which will probably figure in the Court of the Colonial and Indian Exhibition of 1886, metamorphosed into diamond "of purest ray serene," and try to conceive the thing of beauty it would be, even if shrinkage in the transformation process reduced its size to one-tenth or even one-hundredth of the original bulk. Meantime it seems curious that Ceylon, so rich in "precious stones" which, with all their brilliancy are simply crystallized and coloured clays, should be utterly destitute of specimens of the king of all gems, seeing that diamonds are found close by us in Southern India and in formations similar to those existing here: laterite, occasionally, and especially in association with corrundum, which in Ceylon is so common and of which our most precious sapphires and rubies are but higher forms.

The paper then stated that of more value to Ceylon economically, beyond all comparison, would be the real discovery amidst its rocks of that form of carbon which ranks next to the diamond and graphite, and which seems to be graphite and perhaps diamond in a less altered form. It needs scarcely be said that coal is referred to.

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The authority of the late Dr. Gardner, formerly of the Royal Botanic Gardens, Peradeniya, the late Rev. Dr. Macvicar and Dr. William King of the Indian Geological Survey, was quoted, to show the improbability of the existence of coal where, as with us, primitive rock formed the surface strata, and the reader proceeded to discuss fully and to show the utter baselessness of statements made by Dr. Gygax, a Swiss minerologist, and endorsed by Tennent, to the effect that in addition to millions of tons of iron, which could be laid down in Colombo at £6 a ton, anthracite, in association with plumbago and basaltic rock, was equally abundant and could be laid down in Colombo at 18s per ton, after cost of digging and conveyance from Sabaragamuwa. If Gygax and Tennent considered the alleged discovery of anthracite important with reference to steam navigation in 1848, how much more important would such a discovery be now, when the powerful but odourless and smokeless heat which the form of coal called anthracite yields would be just what is wanted by our expanding tea industry, while, as regards the requirements of steamers, it need only be mentioned that between 1880, when Colombo Harbour first afforded moorings for steamers, and 1884, the imports of coal into Ceylon had gone up from 80,000 to nearly 200,000 tons, the average value being over R20 per ton. But while bituminous coal was found in India anthracite did not exist there, the nearest approach to it being crushed coal near Darjiling, which had been converted into semi-graphite. But, while dogmatism was deprecated, entire scepticism was expressed as to the existence in Ceylon of anything more closely resembling coal than the peaty matter found, amongst other places at Nuwara Eliya, and which, compressed and dried, might be useful as a fuel. What seemed beyond question certain was that neither Dr. Gygax nor any other human being had ever seen anthracite in our gneiss rocks, and as to the alleged discovery of the mineral in enormous quantities, Mr. Ferguson said: In the history of scientific exploration and report, and of colonial history and progress there seems to be no greater fiasco.

A curious circumstance in connection with the alleged existence of anthracite in Ceylon was mentioned. The late Mr. John Armitage, a well-known and enterprising merchant, saw in the British Museum a specimen of fine iridescent anthracite labelled as from Saffragam, Ceylon. It was said to be from the collection of a Colonel Greville, a name not prominent in the annals of Ceylon, and Mr. Ferguson added:—To show how confusion may arise, I need merely mention that through the dropping of a comma, plumbago is represented in successive works, including the *Encyclopædia Britannica*, as found in "Travancore Ceylon," as if the localities were one. There is the case of *columba* root, too, which received that name because ships touching last at Colombo brought the bitter root to Europe from India. But the crowning absurdity was that the Emigration Commissioners, who had in 1846 the ordering of such matters, instead of saying to Messrs. Armitage and Tindall, "We will refer to the Governor of the colony for information," or, "You go and prospect and let us know what you find and under what circumstances, make your offers, and we will consider them," jumped instantly to the conclusion that anthracite of such quality, in such plenty, and in such circumstances of cheap acquirement, existed in Ceylon, that 40 per cent would be a fair royalty to charge! There the matter ended, until Gygax's alleged discovery was announced, two years subsequently. It seems just possible that in both cases the supposed anthracite was the rocky hard form of plumbago, which the natives call *yabora* or iron dross. It was suggested that finally to set at rest the question of what minerals or metals might and might not be expected to occur in our Ceylon formations, the Asiatic Society should press on Government the propriety of asking for the loan of the services of a competent geologist like Dr. William King of the Indian Geological Survey, who, with his experience acquired in India, could pronounce on all important points in a period of time probably not extending beyond a year.

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Passing over much detail of a more or less interesting character, we quote as follows:—

But if the diamond, amber, coal, and petroleum are absent from our rock formations, happily there can be no question as to either the quality or the quantity of our mineral carbon in the shape of plumbago, of which indeed, in the form most valuable for the manufacture of metal-melting crucibles, Ceylon seems to have as much a natural monopoly as she has of first-class cinnamon in the vegetable world. There are, no doubt, vast deposits of graphite in North America, especially in Canada, but the mineral seems to be generally diffused in rock from which it is difficult and expensive (labour being scarce and dear) to separate the small particles. Graphite, although rare in a form economically valuable, seems very widely distributed over the face of the earth. In India plumbago has been found in a large number of places, and has been the subject of many experiments and much discussion, but the results have been hitherto disappointing. It generally appears sparingly in very quartzy rock, and in heavy ferruginous gneiss. The mineral is deficient in lustre, contains much iron, and one specimen gave 35 per cent of lime. Lime is, perhaps, even more fatal to the value of plumbago than iron, and although graphite may occur in the magnesian limestones of Ceylon (I never heard of but one instance), it is quite manifest that digging in the dolomite need never be resorted to, the mineral being so plentiful in our quartzy gneiss, where the only enemy encountered, and that, happily, not very frequently, is iron. Like some other adversaries, this one sometimes appears in guises the most radiantly beautiful, in the present case as pyrites varying from splendidly crystallized masses, with facets polished like finest silver, and again simulating auriferous treasures by putting on the most glorious colourings of gold, shading away to a lovely and delicate green, indicative, this tint, it is supposed, of the presence of sulphate of copper.

This auriferous coloured pyrites is appropriately named in Sinhalese *diya rat-ran*, or "water gem-gold," the recognition of water as the agent to which the formation and its brilliant colours are largely due being, curiously enough, in perfect accord with the conclusions of the most advanced geological scientists.

To Mr. Williams, Acting Government Agent of the North-Western Province, I am indebted for a collection of interesting specimens from Polgola on the road to Dambulla, showing how plumbago is associated with and forms round a nucleus of crystalline or semi-opaque and sometimes garnetiferous quartz (the position of the minerals being, I am told, occasionally reversed), and quite a number of pieces of rock which the non-scientific might well be excused for regarding as coated and permeated with brilliant golden ore. These may be regarded as the flowers of the subterrannean regions where plumbago is mined. I am bound to state, however, that the brilliancy of iron pyrites has no effect in modifying the inimical feelings with which those connected with the plumbago enterprise regard the mineral, while they talk with disapproval and disgust of the *yabora*=(*a*)*ya* iron, *bora* dross: iron dross, the hard iron-like form of plumbago; and anyone desirous of procuring specimens will be made heartily welcome to what in the eyes of the plumbago dealer is associated with a rocky inferior and unsaleable product. But truly the pure soft mineral itself, in its various forms of crystallization, the most prevalent being a radiating star-like arrangement, and its variation of sparkling colours from steel grey to plates of jet black, may be regarded as a veritable "thing of beauty." A collection of first-class lumps, each highly polished and lustrous, intended for shipment to Germany, which could be seen at Mr. W. A. Fernando's store recently, was certainly a striking sight. In connection with this collection of silvery masses, Mr. Fernando showed us specimens of a dark-coloured variety, of needle-like formation, which he said he had been requested by his customers to make up separately, as the ordinary mills could not easily grind that partic-

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ular quality. Graphite generally, like iodine, shows a bright metallic sheen, but it is at once distinguished from the true metals by its soft and unctuous, mechanical condition. I am speaking of first-class mineral, for, showing us a specimen of plumbago formed, apparently, over an ironstone nucleus, Mr. Fernando declared such ore to be unsaleable. In truth, the reasons why our Ceylon graphite is so much sought after, are the entire absence of lime from the mineral, and in most cases its equal freedom from ferruginous particles, the small proportion of foreign substances, if any, being volatile matter and minute fragments of silica and alumina. Besides grinding to extreme fineness, an acid bath is used thoroughly to purify graphite used for certain delicate purposes, such as electrotyping, when the finest and purest dust is required to coat surfaces of wood, plaster of Paris, and guttapercha, &c., to render them conductive. An authority, of all in the world, perhaps, best qualified to speak, describes Ceylon plumbago as combining the two qualities of being almost as refractory as asbestos and at the same time the most perfect conductor of heat.

The various portions of the world in which graphite is found were then enumerated, from North America to Japan, and the first mention of Ceylon plumbago were traced, evidence not being forthcoming to prove Bennett's assertion that Ptolemy, who wrote in the second century of our era, had referred to the mineral. The Historical records of Ceylon are as silent regarding plumbago as they are with reference to cinnamon, but a medical treatise of the fourteenth century (about the date of a MS. extent in Europe said to be ruled with black lead), speaks of *kaluminiran* (black mica), as a medicine when boiled and subjected to the detergent influence of *Euphorbia* juice. The Cumberland black lead was also sought after as a medicine about a century and a half ago.

To quote again:—The officer of the late Ceylon Rifle Regiment who wrote a book on Ceylon stated that Thunberg, the Scandinavian naturalist, who wrote in 1777, was the first to notice plumbago as a product of Ceylon. This was an error. Robert Knox, who wrote in 1681, mentioned the existence of the mineral; and Valentyn gives a letter of a somewhat earlier period by the Dutch Governor Ryklof van Goens, dated 24th September 1675, addressed to his successor the Governor-General Jan Maatsuyker, in which he mentions veins of plumbago (*potloot*) in the hills and mines in the lowcountry. He described it as a product of quicksilver, an error which, repeated, may explain the alleged discovery of a mine of quicksilver near Kotte soon after the British took possession of Colombo. So important was the latter discovery deemed at the time that a military guard was placed over the mine; but subsequently the existence of quicksilver in Ceylon became as mythical as that of anthracite seems now to be, or the alleged discovery of coal by the Dutch who are said to have disregarded it in view of the abundance of wood fuel. * * * A Mr. Ive, who wrote apparently in 1755, professed to have discovered "black lead" and copper ores in Ceylon. Mr. W. P. Ranesinghe has unearthed for me the tradition that the last King of Kandy, infamous for his cruelties as he is famous for his æsthetic taste, added to his many-sided character a development of the commercial instinct, supplying, it is said, plumbago to merchant ships, more than seventy years before such enterprizing traders as the Fernandos and De Mels appeared on the scene. The tradition seems also to indicate that some of the plumbago in which the monarch traded was dug from a mine on the lands of Molligoda Disawa.

Then followed references to notices of plumbago by Cordiner and Davy. Bertolacci, although he dealt with every export of any importance in detail up to the end of 1813, makes not the slightest mention of plumbago. The export of the article must have commenced between 1820 and 1830, however, for Mr. Joseph Dixon, the founder of the great American Crucible Company, obtained a shipment of Ceylon plumbago in 1829. In that very year Col. Colebrooke,

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one of the Commissioners on Ceylon affairs, stated in his report that provision had been made for the delivery of cinnamon and black lead in the Kandyan Provinces (then including the Seven Korales) at fixed rates. Reference to three Government Calendars shows that there is no mention of plumbago until 1831, when it was included in the list of articles liable to export duty, the rate being 10*d.* per cwt. The amount of revenue at this rate in 1832 was £22 18*s* 6*d.* The mineral did not, however, assume real importance in the commerce of Ceylon until 1834, and for the half-century which has elapsed between that year and the end of 1884 I possess, thanks to the courtesy of the Assistant Auditor-General, Mr. C. Dickman, full details of the rise, progress and fluctuations of the trade until from small beginnings it has in the past five years attained truly important dimensions whether regard be had to the quantity and value of the mineral exported, or the revenue derived by Government from a royalty finally fixed in 1877 at the very moderate rate of R5 per ton.

For the first three years of the period beginning with 1834 no export duty was levied on this article. From 1837 to 1846, and again from 1858 to 1869, a duty of 2½ per cent was levied, which yielded in the earlier period sums so low as R12·25 in 1839, rising to R759 in 1846. In the second series of years, when export duties were levied expressly for railway purposes, the duty rose from R1,190 in 1858 to the appreciable sum of R22,240 in 1869. The latter sum was levied on 226,132 cwt. valued at R889,620. The rated duty seems, therefore, to have been as nearly as possible one-tenth of a rupee per cwt. The only Customs impost to which plumbago is now liable is apart, from the royalty, 7 cents per barrel, recently exacted for harbour purposes. As each barrel contains 5½ cwt. net of mineral, the burden is only a fraction over one cent per cwt., in addition to the royalty which since 1877 has been levied at the rate of R5 per ton, or 25 cents per cwt., equivalent to 2½ per cent on the Customs valuation of R10 per cwt., but rising to 5 per cent if the real value is only about R100 per ton. Previously to 1851 no royalty was levied, and the varying rates since then have been :—

In 1851	per ton ...	... 4*s.*	In 1864	per ton ...	... 16*s.*
„ 1852	„ ...	... 5*s.*	„ 1869	„ ...	... 30*s.*
„ 1859	„ ...	... 17*s.* 6*d.*	„ 1873	„ ...	... R10
„ 1862	„ ...	... 14*s*	„ 1877	„ ...	... R5

There can be no possible question, it would seem, of the propriety of exacting a royalty, moderate in proportion to its market value, on this mineral, which is entirely an article of export, and which is as much the property of Government, or the people of Ceylon, as are the pearly treasures of the "oyster" banks off Arippu,—providing, too as the revenue from plumbago does for the construction, amongst other public works of means of communication which facilitate and cheapen the operations of the diggers. We could only wish that copper, tin, nickel, and other ores which have been so positively written about as occurring in Ceylon with gold, which beyond question does exist, were found in quantities sufficient to add appreciably to the revenue in the shape of royalties. The one necessary qualification is of course, that the amount of the tax should be such as not to bear heavily on an enterprise which is always toilsome and often precarious. Taking the average value of plumbago at R10 per cwt., the Customs figure, the present impost of 25 cents is, as noticed above, only equivalent to a rate of 2½ per cent, which certainly cannot be complained of as unduly onerous, however justifiable complaints and remonstrances were when 14*s*, 16*s*, and even 30*s*, per ton were exacted, or R10 between 1874 and 1877. The present rate has the merit of being light, easily collected, and productive, for in the five years ended 1884 an average export of nearly 12,000 tons per annum, of an annual value of R2,400,000, yielded royalty equal to a yearly average in round numbers of R60,000. When the proceeds, of digging licenses and leases of Crown lands, and stamps on those leases

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are added, the average may be raised to R65,00. The maxima of quantities exported, total value, and total revenue were reached in 1883, when the figures were :—

Plumbago exported	cwt.	262,774
Value @ R10 per cwt.		R2,627,737
Total revenue { Royalty ... R65,694; Leases and licenses 4,727 } ...		R70,421

Wonderful contrasts these, even if we reduce the Customs valuation by one-half, to an export of only 423 cwt. in 1839, valued at only R490, or a little over R1 per cwt., and yielding to the revenue of the Colony only R12·25, a sum scarcely worthy of collection! The totals for the whole period of half-a-century of the export trade in Ceylon plumbago are striking viz :—

Quantity exported	cwt.	3,526,000
Value of this quantity		R25,742,000
Contributions to revenue		R841,000

Crediting plumbago revenue with items brought to account under stamps and other headings, the amount might be raised to R900,000, and, had Government always got its own in the shape of royalty, the round million of rupees would be considerably exceeded.

Taking averages of qualities and periods, it is probable that R200 per ton is too high a valuation for this mineral, and that twenty millions of rupees would more nearly than twenty-five millions represent the total value of the plumbago exported in fifty-one years, for which figures are given. At any average price of less than R100 per ton it would probably not pay to dig plumbago, and as a matter of fact what was evidently over-production between 1880 and 1883 led to a reaction in 1884, when not only did exports fall off, but operations in the preparing yards in Colombo were stayed for a time by general consent, some not opening again even when the probability of a war with Russia gave a fresh fillip to the trade.

It is a melancholy fact that plumbago is one of the class of articles like "villainous saltpetre" and some others, the trade in which prospers when war has broken out or when warfare is threatened. The reason in the case of our staple mineral is, that the chief use by far to which Ceylon plumbago is put is the manufacture of crucibles, nozzles, &c., employed in the preparation of Bessemer and other steel, now in such large requisition for shipbuilding, plates for ironclads, torpedoes, shot, shell, &c.; this, in addition to the melting of the precious metals, for which crucibles of refractory plumbago are eminently suited from their superior strength and perfect smoothness. There are many minor uses to which plumbago is put, as will hereafter be shown, but I believe I am right in stating that its extended consumption (if that word can be correctly applied to an article which is almost unconsumable) in recent years is due to the great and rapid advance of the steel industry on both sides of the Atlantic, not merely to provide materials for ships, durable and light, but for the dread weapons and appliances of modern warfare, such as Krupp and Armstrong guns, steel shot, &c. But the abundance of the ore in Ceylon, and the enterprise and activity with which the mining, preparing and shipping of the mineral have been pursued, have in this case, as in so many others, recently led to production considerably in excess of demand, so that the profits of the pursuit, never very great and always precarious, have recently been low or *nil*.

When at its highest market value I do not suppose that Ceylon plumbago ever sold for more than £50 per ton: indeed the higest price of which I have evidence is £48 realized by Mr. W. A. Fernando, of Brownrigg Street, Colombo. What is this to the celebrated Borrowdale pencil "black-lead." mines, which, after having been worked since the reign of Queen Elizabeth, recently gave out, so that now pencils picked up at Keswick as curiosities cost sixpence each! In the report of the Matara district for 1870 the Assistant

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Government Agent stated:—"To meet Ceylon plumbago in Cumberland was certainly a surprise; but when recently at the English Lakes I learned that plumbago from this Island was mixed with the local graphite to make good pencils."

In the palmy days of the plumbago mines of the North of England the black-lead obtained from them was valued at 30s. per pound, or over £3,000 per ton, or within about two-thirds of the price of ordinary gold. We cannot be surprised therefore to learn that a couple of centuries before the world heard of the gold escorts of California and Australia, the black-lead of the English Lake region was guarded in its transit, in carts, from mine to manufactory by parties of military, the robbery of black-lead mines being, by an Act of George II., constitued a felony. The Act, curiously enough, recited that black-lead was employed for divers useful purposes, and more especially for the casting of bomb-shells, round shot, and cannon-balls. The connection, therefore, with the art of war of the mineral so long associated with the most intellectual and humanizing of the arts of peace—writing and drawing, to wit—does not date from yesterday.

The quality of the Borrowdale ore, dark-coloured, pure and soft, rendered it eminently suitable for pencils of the finest descriptions, and for about two and a-half centuries the world was practically supplied with pencils from this one source. From one pound of the ore, worth 30s. or at the rate of £168 per cwt., the number of pencils cut averaged from 18 to 20 dozens. The mineral was stated to be found in pipes, strings, and irregular masses called "sops," a description which, substituting modern terms for olden, applies equally to the Ceylon graphite formations. Since the exhaustion of the Cumberland mines, the best ore for pencils is *said* in some books to be obtained from Siberia, while no doubt the massive and soft stove polished black-lead occurring in various parts of Germany—Bavaria, Bohemia, &c.—is applied to the manufacture of pencils. It cannot be questioned also that some of the finest quality Ceylon plumbago is thus used in Britain, and also in the United States.

Then followed notices of the various methods of manufacturing pencils, from the period when blocks of black-lead were sawn into pieces until Conte of Paris in 1795 discovered the method now universally adopted of mixing finely ground graphite and clay together and subjecting the mass to pressure and heat, plumbago crucibles being used to give a final firing to pencil-leads. In the one city of Nurnberg 250,000,000 of pencils, worth £400,000 are turned out annually, so that Mr. Ferguson felt justified in estimating the production of the whole world at 1,000 millions, worth at least £1,500,000. Clay in varying quantities is used to give adhesion to crucibles, but those with the largest proportion of plumbago are of course the best.

To quote again:—The Canadian and United States plumbago is of as pure a quality as that of Ceylon, but good as the American ore is, when freed from the rock in which it is generally scattered after the fashion of mica, I suspect the high cost of the labour necessary for first mining and then separating the mineral by the wet process—for the dry has proved a failure—will prevent continued and successful competition with Ceylon. We shall soon see, however, for the Joseph Dixon Cruicble Company had produced in 1882 a quarter of a million pounds of native plumbago, against 16,000,000 pounds imported from Ceylon, and a determination to "go ahead" was expressed. Some as yet unthought-of machinery, cheap chemicals and appliances must, however, be brought into play before the pure, massive Ceylon product and our far cheaper labour are distanced in the race. And if, as Professor Dawson states, some of the Canadian ore is fibrous enough to indicate by its texture its vegetable origin, there is no room to suspect that, however pure the mineral may be as carbon, its mechanical condition cannot be so good as that of the more highly crystallized Ceylon plumbago. One important element in the question is, that, according to our American friends themselves, enter-

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prize and competition have had such influence, that Ceylon plumbago can be obtained by them at 25 per cent of what it cost some years ago.

The effect of competing demand for the substance, however, between 1850 and 1870, chiefly on the part of the Battersea Crucible Company in England and the Joseph Dixon Company in the United States, was to enhance the value of the ore to such an extent in Ceylon as to produce temptations to cheating, which the native headmen, whose business it was to weigh the output and collect the royalty at the pit's mouth, were unable to resist. These estimable servants of Government cheated the diggers out of bribes by threatening to report them as having surreptitiously removed plumbago on which royalty had not been paid, and they impartially cheated Government by accepting bribes to largely under-report the quantities really dug and removed. The Customs figures enabled the Government authorities to appreciate the vast extent to which the demoralizing system had gone, and so in 1873 legislation was initiated, the main object of which was the collection of the royalty at the custom-house—a mode in itself far preferable to the direct system of collection previously in force, and securing every sixpence of royalty due, because, practically, every hundredweight dug is exported, the quantity as yet used in local foundries or for any local purpose being quite insignificant. I believe a few crucibles for gold and silversmiths' use are locally made, and the result of inquiries made by Mr. W. P. Ranesinghe at my request is that Ceylon potters occasionally employ the mineral for giving a glaze to pottery, as is the practice in India.

The mercantile community strove hard in 1873 to make out a case for the entire abandonment of the royalty, but the Press supported Sir William Gregory's Government in resisting the pressure brought to bear in this direction, only that the *Observer* strongly urged a rate so low as R5 per ton, which after four years' experience of R10 per ton, under which exports declined, was conceded in 1877. Under this rate, which is still in force, the exports more than trebled in the six years between 1878 and 1883.

Then follows a description of the largest plumbago mine in Ceylon:—

Mr. De Mel has been amongst the most prosperous of all who have engaged in the plumbago digging enterprize in Ceylon, his prosperity being mainly due to the rich yield of his Kurunegala district mine, which is by far the most important in Ceylon, having been sunk to a depth of 450 feet near the base of a hill, Polgola, which seems to be largely composed of fine quality plumbago. From this mine Mr. De Mel obtained an average of 800 tons annually for eleven years, his profits, he authorizes me to say, being at the rate of £2,000 per annum. No wonder if, notwithstanding lessened production and profits in the past two years, connected with this mine there is a steam crane for raising water and a considerable length of Decauville railway for the carriage of the ore from pit mouth to cart, or that the enterprising owner has commenced a base level tunnel at an estimated total cost of £2,000 to free and keep the mine free of water, whether the result of springs in the rocks or of monsoon rains. The effect of the latter during the recent exceptionally heavy burst of the south-west monsoon in May was to fill up the pits and put a stop to digging everywhere. This, irrespective of a fall of £2 per ton from the price to which the mineral had been sent up the war scare.

The tunnel in Mr. De Mel's mine, when completed, will not only carry away water but facilitate the output of mineral from the lower which are generally the richer strata, besides ventilating the mine so as to prevent injury from mephitic gasses or inconvenience from the smoke of explosives employed in blasting. The draft will also alleviate the heat in the interior of the mine, which the workmen now complain of as sometimes intolerable. For blasts under water large quantities of dynamite cartridges are employed, in addition to gunpowder used in portions of the galleries comparatively free from moisture. The wages paid to diggers in this mine, chiefly lowcountry Sinhalese,

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vary from 9*d.* per diem for coolies to R1 for those who perform the boring and blasting operations. In the Pasdum Korale there is a system of payment for labour by shares in the profits, after all preliminary expenses defrayed by the capitalist have been reimbursed.

The hill in which Mr. De Mel's mine has been opened—Mr. W. A. Fernando having another at a higher elevation than De Mel's with a depth of 330 feet—seems to be permeated in its whole extent by generally horizontal veins of the richest plumbago, associated with beautifully snow-white crystalline to semi-opaque quartz, the latter occasionally showing specks of garnet and bands of soapstone, and Mr. De Mel brings to the surface practically pure plumbago. As regards the generality of pits, he agrees with the estimate of Mr. W. W. Mitchell (who has probably purchased, prepared and shipped to America as well as Europe more plumbago than any European merchant who ever resided in Ceylon) that the extraneous matter in the shape of earth and rock brought to the pit's mouth is equal to one-half of the whole, about 10 to 15 per cent being the proportion carried to Colombo and separated from the ore in the preparing yards. Mr. Fernando's estimate, however, of foreign matter brought to Colombo is 5 per cent for pieces of quartz round which plumbago adheres, and 2½ per cent for minute fragments of silica, iron, &c., mixed with the smaller pieces and dust. Any person who has witnessed and appreciated the difficulty and the expensiveness of the processes whereby small fragments of rock are separated from the lower classes of plumbago in Ceylon can well imagine the obstacles to profitable separation of the mineral from rock in America, where there are no masses but only scales of the mineral distributed throughout the rock.

Then followed a notice of a mass of plumbago only 14 lb. short of 6 cwt. which De Mel exhibited when the Prince of Wales visited Colombo, and the statement that large masses are sometimes although pure carbon yet of such hard consistency as to be commercially valueless. Mr Ferguson suggested that this form of plumbago and not the softer kind should be used for sculpturing elephants and other objects. Then followed a description of the various systems in force in the three Provinces to which plumbago mining is practically confined. In the North-Western Province all the mines are on private property. In the Southern Province only licenses to dig are charged, at the rate of R10 per annum, but no rent. In the Western Province, besides the charge for licenses, a rent-royalty of one-tenth of the plumbago dug or its equivalent value is levied, which adds considerably to the revenue. Sir Wm. Gregory in 1873 announced that the policy of the Government would be to lease and not to sell plumbago lands, so as to prevent a monopoly in the hands of the rich. Mr. Saunders is, however, in favour of selling such lands outright, but only in small lots. He quotes in favour of his view the results of a sale in 1880, when a lot of 1 acre, 1 rood and 13 perches realized R8,150. As a general rule the rent-royalty exacted in the Western Province is somewhat below the sum of R5 per ton charged on export, so that the total impost on such plumbago is R10 per ton. Owners of private mines, and diggers on Government lands in the Southern Province, pay only R5. Mr. Ferguson said of the leasing system:—

The merit of the system, provided the rent-royalty is moderate, is, that the lessee of the land pays only and just in proportion to the productiveness of the land he has leased, payment being accepted in money or in kind. At the end of each year the lease can be either renewed or abandoned, and plumbago lands which have been for a certain time abandoned, and which evidently do not contain appreciable quantities of the metal, are sold on the terms applied to ordinary Crown lands.

At present as sources of plumbago the North-Western Province seems entitled to first rank, the Western following as a good second, while the Southern is a distant third, the Galle Customs returns showing an export of one-tenth of the whole plumbago sent away against nine-tenths from Colombo. Three-fourths of

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all the plumbago exported from Ceylon are dug in the Kurunegala and Kalutara districts. It was then noticed that exaggerated figures have appeared in the Blue books as to the number of plumbago mines in the island, from the inclusion of abandoned pits and mere holes. While the pits opened from first to last must amount to thousands, those being worked at any one time may be taken at a few hundreds, from 300 to 600. Water in the soil and from rainfall is the great difficulty. To quote:—

As a general rule, graphite seems to exist not far from the surface, on which its presence may be revealed through fissures, while, in regard to this mineral as well as gold and other ores, indications in streams guide explorers up to the including rocks, generally quartzy gneiss, in which the mineral is embedded or diffused. Mr. De Mel tells me that very good plumbago is often found near the surface, but that as a general rule, the lower the digging operations go the better the quality and the larger the quantity of the mineral. Of course, the purer the finds are, and the larger the masses the better, but a visit to any of the preparing yards in Colombo will show that besides the cost of prospecting and mining and the uncertainty of ultimate success, a good deal of expense is involved in conveying a considerable proportion (already noticed) of extraneous matter to Colombo, there to be hammered, cut with small axes, picked, sifted, and washed out.

Still, with all its drawbacks, the plumbago enterprise is valuable to the country, not only for the revenue it yields but for the generally remunerative employment it has given to many thousands of the population (from 15,000 to 20,000 men, women, and children, probably, including cartmen and carpenters), especially since the period when the collapse of the once great coffee interest led to so much distress in the conntry. The Kurunegala Administration Report of 1873 stated that in that district alone, the plumbago industry had given employment to some 5,000 persons. The Galle report for 1872 estimated that each mine required from two to eight or ten miners, and even up to fifty or sixty, at high wages. At a period when the plumbago industry was at the height of its prosperity, Mr. De Mel and other mine owners had almost concluded an arrangement with Messrs. John Walker & Co. for a light railway line from the mine region to the Government railway. Depression in prices caused this design to fall through, but the day cannot be far distant when Kurunegala at least will be connected with the Government railway system at Polgahawela, forty-five miles from Colombo. The Western Province plumbago found in the Pasdun Korale (a korale which is famous for the quality as well as the quantity of ore it produces) does not come on the railway at Kalutara. Once it is loaded in boats it comes by water all the way to Colombo.

A return furnished by Mr. Pearce shows that nearly one-half of all the plumbago exported from Ceylon comes on the railway at various points, mainly at Polgahawela, the quantity so carried in 1882 being no less than 5,642 tons.

To show the vicissitudes of the plumbago enterprise, I may quote from the Sabaragamuwa Report of 1873 to the effect that plumbago, which formerly sold at R200 per ton, then realized only R90, while the working expenses had considerably increased in consequence of the enhanced prices of labour. It will be remembered that 1873 was the year in which the change was made to the collection of royalty at the Custom-house, in anticipation of which the great manufactories in Britain and America had provided themselves with stocks of the mineral. Hence a fall in exports and prices. Eleven years subsequently, in 1883, Ceylon sent away her largest export of plumbago, but the depression had even then set in, which led to greatly reduced shipments in 1884. In the one matter of cask-making, however, the increase in the export of plumbago during the past five years must have largely filled up the void created by the decrease in coffee. Hora, one of our most inferior timbers, can be utilized for plumbago casks and as the casks are uniformly made to hold a quantity somewhat over a quarter of a ton (5¼ cwt. nett), an average of

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45,000 casks per annum for the past five years, or a total in the quinquennium of 225,000, must have given, in their manufacture, remunerative employment to a considerable number of carpenters who had previously been largely dependent on cask-making for coffee.

The industry now so wonderfully successful in the North-Western Province is apparently of quite recent origin. Gate Mudaliyar Jayatilleke states in reply to my queries as to whether there were anything hereditary, or a system of payment by shares, amongst the mining class :—

"All the plumbago quarries that are now worked in the District are purchased from the Crown. No licenses have ever been applied for or granted to dig plumbago. The diggers are paid wages, and they are coolies from the Siyane and Hapitigam Korales, in the Western Province. Very few Kandyans are employed, as they are not handy in blasting and excavating any depth of more than 15 or 20 feet."

I may add that but few Tamils are employed in the Ceylon plumbago mines, which are, I believe, exclusively owned by Sinhalese, although no doubt the ubiquitous Chetty of Southern India is interested in the recovery of advances made or supplies furnished in some cases.

To Mr. G. S. Williams, the Acting Government Agent of the North-Western Province, I had previously been indebted for responses to my questions, thus:—

"The pits are about sixteen miles north-east of Kurunegala on the Dambulla road. There is a good resthouse at about the 12th mile, and the journey in decent weather is easy enough.

"The trade altogether failed last year—I mean no digging was done—on account of the fall in price, but this year operations have been resumed, and I am told that about 2,000 men are employed. The plumbago is found in rocky ground in which are very large crystals transparent like Derbyshire spar.* De Mel is the owner of the principal pit. The resthouse is at Gokerella. It is not mentioned in Fyers' Itinerary, but is between Polgola (about a mile beyond it) and Ambanpola. On page 20 of the new edition (1881), Part I., you will find Wetakeyyapota, which is 15·55 miles from Kurunegala, and 0·55 mile beyond that, or 16·10 from Kurunegala, 'minor road to plumbago pit on right.' There are other plumbago pits, some actually by the roadside."

It thus appears that the best deposits of plumbago at present worked in Ceylon are situated at the base of the north-western portion of the mountain zone. The mineral exists at high elevations, up to Nuwara Eliya indeed, but apparently not in paying form or quantity. It would appear that while the veins of plumbago run generally from south to north in the Western Province, their direction in the Kurunegala district are from east to west.

It seems possible that if digging for gems and plumbago continues on a large scale, and becomes widespread, legislation may be needed such as exists regarding the protection of wells, and that measures to prevent accidents from subterraneous blasting and the collapse of tunnels, as also to secure free ventilation, may be necessary. Though not so much so as gem-digging, plumbago mining is, no doubt, largely a speculative pursuit, involving the loss and demoralization which ever accompany gambling pursuits. The ultimate result is, however, beneficial to the people and the country.

From some of the Administration Reports consulted, it would seem that the plumbago industry is a recent one in the district of Sabaragamuwa, although the existence of the mineral must, surely, have been revealed to the gem-diggers who have for ages been engaged in searching for the sapphires and rubies for which the region around "the city of gems" (Ratnapura) is so famous.

A vivid idea will be formed of the extent to which Government—that is, the public—were formerly cheated under the system of collecting the royalty at the pit's mouth, when it is mentioned that while 226,000 cwt. were exported

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* Crystalline quartz, of course, as lime taking the form of spar, seems to be non-existent in Ceylon?

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in 1869, the royalty recovered was only R16,000, against R65,000 on 263,000 cwt. in 1883, the rate in the latter year being only one-third of that in the former.* The extreme rate of 30s. per ton in 1869 evidently proved an irresistible temptation to diggers and headmen, and the royalty recovered was only one-tenth of the sum which ought to have been collected.

As has been proposed in the case of chips in the cinnamon trade, it would almost seem desirable that low quality dust should be excluded from the exports. Buyers are strongly inclined to confine their attention to lump of best quality, and I have heard that some of the local dealers have injured their own reputation, and that of the article in which they deal, by mixing lower qualities with the higher. As matters stand the proportions in which the mineral seems to be exported are :—lumps, 1st and 2nd quality, 50 per cent; chips and dust, each 25 per cent; so that dust is only one-fourth of the whole. In the home market during the past five years of unprecedented outturn, I am informed that prices have ranged from £20 per ton, the highest for lump, down to £10. In Colombo, apart from the exceptional case in the experience of Mr. W. A. Fernando, already mentioned, the highest prices ever known are stated to be R320 per ton for fine, R270 for ordinary, R95 for dust. In the old sailing-ship days, plumbago was taken at an exceptionally low rate of freight as "dead weight." Since 1880 the average rates for a ton of 20 cwt. have been :—steamer 40s; sailer 35s.

The United States are our best customers in the case of plumbago, the Ceylon form of which the late Mr. Joseph Dixon saw and appreciated in 1827, and of which he secured a first shipment in 1829. In 1882 the quantity received in the United States from Ceylon was stated at 16,000,000 lb., and of the *comparatively* small quantity of 22½ millions of pounds sent from Ceylon in 1884, more than half went to the United States. But a memorandum showing the various countries for which the plumbago exported in the past five years was destined will clearly indicate how important a customer for our mineral we have in the United States with its large steel manufacturing industry. The general result is that of the whole export of 1,170,000 cwt. in the five years, 641,000 (or very considerably more than one-half of the whole) went to the United States, the United Kingdom taking the bulk of the remaining 529,000 cwt.

Out of an export of 263,000 cwt. in 1883, Britain took 119,000, and the United States 142,000, leaving only 3,000 cwt. for all other places. The memorandum referred to is appended as a note.† It seems probable that three-

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* How striking is the illustration here afforded of the value of indirect (and especially Customs) taxation, rather than a direct levy, in the case of Orientals. No greater fiscal boon could probably be conferred on the people of India and Ceylon than—if it were possible—the collection of all Government dues through the Customs Department, so saving an amount of oppression on the one hand, and of bribery and corruption on the other, of which European administrators never get more than a faint idea.

† Plumbago exported in each of the last five years, showing the countries to which the mineral was shipped :—

	1880. cwt.	1881. cwt.	1882. cwt.	1883. cwt.	1884. cwt.
United Kingdom	70,276	89,709	143,450	119,812	84,981
Holland ...	—	—	—	488	945
Trieste ...	107	4,217	1,828	—	210
France ...	507	699	300	294	884
Hamburg ...	—	4,031	—	—	816
U. S. of America	133,556	160,259	113,451	141,664	94,088
British India	1,095	109	999	326	506
Australia ...	197	885	118	—	—
China ...	—	—	12	—	—
Hongkong	—	—	8	739	—
Total...	205,738	260,909	260,166	262,773	182,425

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fourths of all the plumbago which Ceylon exports is used in the great crucible factories of Britain and the United States, that established by the Messrs. Morgan Bros. at Battersea, and the crucible factories of Jersey City, New Jersey.

Notices then followed of the Battersea Crucible Works, and those of the Joseph Dixon Company, New Jersey, and it was stated that a vast fund of information regarding plumbago and the very numerous and varied uses to which it is put, were quoted from descriptions of those extensive establishments.

The Battersea Works were founded by the Brothers Morgan in 1855. The American establishment had been at work long before this period, but no doubt its productions did not go beyond local demand, for in a notice of the Battersea works we find it stated that previously to 1855 crucibles were almost exclusively imported from Germany. Now that country, together with other centres of industry on the Continent, is principally supplied from Battersea, where crucibles are turned out at from 8d per dozen, up to a gigantic melting pot costing £6 5s and capable of taking in 1,000 lb. of steel. Such a crucible can bear from 8 to 10 meltings, while in the case of gold a crucible taking in 1,200 ounces can sometimes stand seventy meltings. So in the case of brass, while crucibles for assaying the precious metals are very carefully manufactured, being rendered porous by the use of charcoal. The absence of coal fuel from Ceylon is probably a fatal objection to local iron or steel manufacture or any extended scale, but for small quantities of superior steel for special local use, I would, with some diffidence, suggest, that crucibles composed of our indigenous plumbago and kaolin clay, both abundant and cheap, might be profitably used. The existence of "millions of tons" of iron ore in Ceylon is not so apocryphal as that of anthracite, and those who owe their origin to Britain are not likely to forget that her wealth in iron quite casts into the shade all the treasures of the diamond mines of Golconda and the gold diggings of California and Australia.

Mr. Ferguson said, commenting on a very able paper by Mr. Orestes Cleveland, of the Joseph Dixon Company:—In most of the works consulted in the preparation of this paper—and they have been many and various—the credit of having first made and used plumbago crucibles has been given to the Germans. Mr. Cleveland awards the credit to the Dutch, and it is certainly significant that the Dutch name for the mineral should be *potlood*, or pot lead, the lead of which crucibles are made (?)—

Again:—And so our plumbago, like our coffee, suffers from the "ways" that are literally "dark" of the adulterators. Mr. Cleveland, in a kind of despair, exclaims:—"Perhaps no article except mustard can be so successfully adulterated as plumbago." He means, of course, for stove polish, because adulteration in the case of plumbago used for crucibles would soon be betrayed in the trial by fire, one great value of the pure plumbago in crucibles being that it conserves carbon in steel when being melted.

As a lubricant for metal surfaces, journal boxes, carriage axles, and all metal bearings, we can easily understand why only the very finest plumbago should be used, the choicest lumps being pulverized till the particles will not glisten but the mass becomes a dead black. It cannot, Mr. Cleveland states, be made fine enough by bolting (he means sifting through silk), but must be floated either in water or air.

I notice, however, from advertisements in the American papers, that "mica grease" as a lubricator is competing white plumbago, but how far successfully I cannot say. What I know is that the writer of a recent article on American minerals strongly supports Mr. Cleveland's view as to the great superiority of plumbago as a lubricator. I am not aware that it is so used to any extent in Ceylon, either in foundries or on the railways, although if all stated regarding its value be correct, Ceylon plumbago ought to be much more largely used in Ceylon than it is at present, as a lubricant and for other purposes. For all uses it would seem that grinding to extreme fineness is essential.

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We now, said the reader, come to some miscellaneous and curious uses to which plumbago is put, the mineral being applied to articles so different as musical instruments, hats and boots, bottles, paint, boats and yachts. Listen:— "For pianos, plumbago is employed to coat the bridge over which the wires are drawn, because of its perfect lubrication; it prevents the wire from adhering to the wood, and should be as free from impurity as that used by the electrotyper, but need not be pulverized as finely. For organs, it is used to lubricate the sides, and should be the same as that used by piano-makers. The German black-lead imparts a peculiar tone to the colours and a softness and smoothness to the touch of felt hats. The very best lump only should be accepted. As it has once been washed and dried in lumps, they will readily separate again in water, and no pulverizing is needed. For colouring dark glass for carboys, bottles, &c., the best German black-lead is used in lumps, but no inferior grade will answer. For paint, plumbago has long been known as possessing great value. The elements do not exhaust it, water sheds from it as from oil itself; and fire does not affect it. The grade need not be the highest. For the bottoms of boats and yachts it has long been used, especially for racing boats; but only the best Ceylon plumbago, very finely pulverized, is valuable."

A substance which, used as a paint, resists the action of the atmosphere and is both waterproof and fireproof, is surely of great economic value, and ought to be specially useful as paint for the numerous tea factories erected or in course of erection in Ceylon.

To quote again:—

Mr. Cleveland's very interesting and valuable notices of the Amerian Crucible Company, and their varied manufactures of plumbago, is supplemented and brought down to so late a date as 1883 by the writer (Mr. John A. Walker) of an article on Plumbago in a volume on the "Mineral Resources of the United States," prepared by the National Geological Survey Department, and supplied to our Library by the Smithsonian Institute, to which my attention was attracted by our Honorary Secretary, when he asked me to write this paper. In the summary prefixed to this volume it is stated that the amount of graphite mined in the States in 1882 was 425,000 lb., worth crude at the point of production 34,000 dollars, equivalent to about R70,000. During the first six months of 1883 the production was estimated at 262,500 lb., worth 21,000 dollars. From Mr. Walker's detailed account we learn that graphite is, as a mineral, widely distributed in the United States; as an ore it is found in but few places in sufficient quantities and purity to be profitably worked.

The attention being paid to the mineral in America may be judged from the fact that samples had been received and reported on by the Joseph Dixon Crucible Company from no fewer than 33 localities between October 1877 and January 1882.

The Joseph Dixon Company had laid themselves out to produce 500,000 lb.; altogether 525,000 lb., valued 8 cents per lb. Let us say 18 cents of our rupee currency, and we get the high value (founded on cost as well as quality?) of R20 per cwt., or R400 per ton. The local production, however, was certainly not much to place against 16,000,000 of pounds imported from Ceylon in 1882, with considerable quantities in the two following years.

Referring to analyses of Canadian and Ceylon graphites, quoted from the American authority, Mr. Ferguson said:—Both are almost absolutely pure, and did the Canadian and United States mineral occur in such a form in the enclosing rocks that it could be cheaply mined and prepared, there would of course be an end of the export of Ceylon plumbago to America. But if, in America, plumbago, however pure, is only distributed in the proportion of 8 to 15 per cent mineral to 92 to 85 rock, those connected with the Ceylon enterprise need not, it would seem, concern themselves greatly with the competition in America of indigenous ore with that from our island.

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Under the heading "Manufactures" there is interesting summarized information, which I quote:—

Proportionate Amounts of Graphite used for Different Purposes.

Manufactures.	Kinds of Graphite used.	Per cent.
Crucible and refractory articles, as stoppers and nozzles, crucibles, etc.	...Ceylon, American ...	35
Stove polish	...Ceylon, American, German	32
Lubricating graphite	...American, Ceylon ...	10
Foundry facing, etc. ...	...Ceylon, American, German	8
Graphite greases	...American	6
Pencil leads	...American and German ...	3
Graphite packing	...Ceylon, American ...	3
Polishing shot and powder ...	...Ceylon, American ...	2
Paint	...American	½
Electrotyping	...American, Ceylon ...	¼
Miscellaneous—piano action, photographers', gilders', and hatters' use, electrical supplies, etc.	—	¼
		100

A table like this will give many of the readers of this paper a new view of the multifarious uses of the mineral carbon called plumbago. It will be observed that, next to the manufacture of crucible articles, the great use of the mineral is for polishing and preserving from rust the ranges of stoves and other cooking appliances, which contribute so much to the neatness, cleanliness, health, and comfort of modern abodes. The proportion used for this purpose in Europe—in Britain at least—cannot certainly be below that given for the United States. There are graphite greases as contradistinguished from lubricants, and the mineral seems to be used for the packing of engines. From the largest forges where tons of steel are manufactured in Pittsburg, down to the studio of the photograher and the shops of the gilder and hatter, plumbago is of valuable use. And not only is it called into requisiton to produce the highest order of steel guns and steel armour for war-ships, but it is good for polishing the sportsman's powder and shot. Gunpowder used for blasting operations is also greatly improved by receiving a glaze or varnish of graphite, the philosophy of the operation being that thus the grains are prevented from absorbing the moisture which exists in mines and quarries.

Graphite enables the electrotyper to prepare and present to the world, cheaply and at will, casts of coins, wood-cuts, copper-plate maps, &c., equal in the most minute and intricate detail to the most highly prized and costly originals. But next to the boon which the real discovery of anthracite or natural coke in Ceylon would be, is the certainty of which we are assured, that in our teeming supplies of plumbago the tea planters of Ceylon can get a paint for their stores, equal in its fire-resisting properties to asbestos paint. If this should prove to be correct, and we see no reason to doubt the statement, the prospect is that Ceylon will be speedily exporting, instead of importing, fireproof paint. Mr. Walker may well say in conclusion:—

"The growth of the graphite industry has kept pace with the age, each new development in metallurgy and engineering offering some new field of usefulness for graphite. For instance, it furnishes the pots for the manufacture of cast steel, and the nozzles and stoppers used in the Bessemer process. It is used in the manufacture of electrical supplies, &c. Fifty years ago graphite was little known and misnamed. Now it is of constantly increasing importance. From an insignificant beginning in the present century the industry has grown to its present proportions."

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A list is then given of twenty-five American firms engaged in the plumbago industry, of which the Joseph Dixon Company of Jersey City, New Jersey, takes the lead, employing 500 hands in the manufacture of everything for which graphite is used. The same number of hands finds employment from the Eagle Pencil Company; while A. W. Faber, probably an immigrant or descendant of an immigrant from Nürnburg, employs 150 persons in his pencil factory. Others employ lesser numbers, six firms giving crucibles as their exclusive manufacture; three, lead pencils; four, foundry facings and lubricants; seven, stove polish and lubricants. It will thus be seen that except in the branch of pencil-making, and perhaps electrotyping, the New World has gone, or is rapidly going in advance of the old in the plumbago industry, which means corresponding advance in the steel industry. It is surely a striking incident in the romance of commerce that this ancient eastern isle of Serendib, the scene of the mythical adventures of Sindbad the Sailor, should be the main source of supply of an article so useful in the industries and elegancies of life, the appliances of peace and war, and the pursuits of the artist and literary man, not only to countries in the eastern hemisphere, but to the regions of the Far Western world.

Having noticed the leading establishments in Europe and America, where our Asiatic ore is so largely utilized, let us now turn to one of the compounds, or yards, with its brick and tar "barbecue" or platform, and surrounding sheds, in which Sinhalese men, women, and boys prepare, assort, and pack the mineral when received in Colombo from pits, none of which are nearer than thirty miles, and some of which are so distant as the District of Hambantota at the eastern extremity of the Southern Province. The chief exhibitor of plumbago at the Melbourne Exhibition of 1880-81 was Mr. W. A. Fernando, of No. 1, Brownrigg Street, Cinnamon Gardens, Colombo, and a description of his establishment which the editors of the *Ceylon Observer* gave in their paper of August 12th, 1880, is in all substantial details, correct in August 1885.

The description was then stated to be reproduced, and the closing remarks were to the following effect:—

We now feel confident that the number to which the pursuit gives employment was much under-estimated in 1880, and that, considering that 5,000 persons were said to be engaged in mining in one year in a single district of the North-Western Province, our higher estimate of an average of 20,000 men, women, and children at present engaged in the various operations of mining, carrying, preparing, packing, and shipping Ceylon plumbago, is not beyond the truth. It is curious that the Sinhalese women should entertain a prejudice against plumbago as poison, seeing that it is included in the native pharmacopœia. We should have expected members of what Artemus Ward called "the female sect" to have been more troubled about the soiling of their persons and clothes by contact with the mineral, but in truth a coating of the shining ore, while easily got rid of by the use of water, produces no such hideous effect as that so familiar to us now in Colombo of the truly uncanny-looking coaling coolies, when proceeding to their houses after loading or unloading the bunkers of one of the multitude of magnificent steamers which now resort to our harbour. A polish of person, if not of deportment and manners, is the result of working amongst even the dust of plumbago, and it is curious to see the dark-skinned coolies of the plumbago stores walking about with their bodies shining as if they were electrotype statues vivified.

In its further metamorphic progress from vegetable to mineral, the form of carbon we call plumbago has certainly taken a great step in advance of the carbon we call coal, in getting rid of smoke entirely, and also of dirt. Coal, however, cannot be accused, as plumbago justly is, with causing a whole roof-covering of tiles suddenly to fall off, from the slipperiness created by wind-blown particles of the greasy mineral. We were greatly amused by Mr. Fernando's statement at the time, but others, Europeans included, who have to

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do with the preparation of plumbago, have fully confirmed his representation as to the incompatibility of pumbago dust and tiled roofs. In this connection we would advise visitors to plumbago compounds to be careful how they bear themselves in such slippery places. A sudden step on to the polished platform may end in an undignified tumble. And this reminds me of the sensation produced many years ago in Mincing Lane by the peculiar appearance of some Ceylon coffee which had been dried on a barbecue where plumbago had been previously spread. An attempt to impart a factitious colouring to the beans was suspected until the requisite explanation was afforded.

As this paper may be read beyond the limits of Ceylon, it may be as well to explain that *cadjan* is a word, curiously enough of Malay origin, applied in Ceylon to plaited branches of coconut palms, used for roofing houses, sheds, carts, &c. *Compound* is a yard or enclosure, and *barbecue* is a platform.

I have already shown, what I may be allowed to repeat, that for the average shipments of 12,000 tons per annum of plumbago from Ceylon for the past five seasons, the yearly supply of casks must have been 45,000, and that the manufacture of these alone must have given welcome and remunerative employment to carpenters out of work by reason of the partial collapse of the staple colonial industry: this apart from the large number of persons (estimated above at 20,000) engaged in mining, carting, preparing, packing, and shipping the mineral.

Let us, therefore, hope that the plumbago industry of Ceylon may continue to prosper and extend, not as the result of wars or rumours of wars, but because of the steady and beneficial progress of the peaceful industries and arts which contributed to the elevation of humanity in all that constitutes comfort, happiness, and means to cultivate the loftier instincts and destinies of our race.

PEARLS AND PEARL FISHERIES.

AN INTERVIEW WITH MR. STREETER.

[*A representation of a Pearling station appeared in the Pall Mall Illustrated Supplement.*]

One or two curious facts came out in the recent correspondence in the papers respecting the pearling grounds in the Southern Seas—a subject surely of universal interest. Mr. Streeter, the famous pearl merchant, was himself one of the correspondents, and we are indebted to him for giving to our representative the following account of his fisheries in southern waters:—

There are not many visible signs of jewels in Mr. Streeter's handsome rooms, which command a fine view of Holborn. The pearl merchant's first necessity, after the pearl, is light, for by nature's light only can a pearl be judged. The tapestry curtains ward off intruding draughts, and their heavy folds partition off the room when division is necessary. But the eye of the stranger falls first on the safe, with its doors thrown open, like an angel's wings. There the eye wanders to the tables clothed in black, to the burnished scales in their covers of glass, to the pearl pliers which lie in a tray on the table, to the cases ranged against the wall. At a table near the window sat Mr. Streeter, gazing with rapture on a lovely pink pearl. After we had had some conversation, he said he would show me some of the "riches of the earth," and bade me plunge my hands into bags full of rubies, bags full of sapphires and emeralds. He opened mysterious drawers, which shut with a sharp spring, and produced shabby cases holding gems of priceless value. Here are strings of iridescent pearls gleaming with prismatic hues. Here dazzling diamonds, shooting forth brilliant rays, there a ruby worth thousands, here a cat's-eye fit for a monarch's finger—diamonds, rubies, pearls, and emeralds, sapphires and cat's-eyes, there they lay before me. But only for a minute. For these things are not exposed.

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GEMS AND GEWGAWS.

"The pearl is the most aristocratic jewel. No one but the rich aristocrat can afford to own it. To be inestimable in its value a pearl should be perfectly round like a marble, pure, and spotless. A black pearl is a rarity, and from a thousand shells you might obtain one. I suppose one of the Rothschilds has the finest collection of pearls in the world, Lord Tweedmouth comes second, and Lord Bristol is a close third. The fashion in jewels alters rapidly, though pearls always take the first rank. At present the emerald is the fashionable jewel, why I cannot say; then come rubies and saphires; the diamond is but a common gewgaw. Everyone can buy diamonds nowdays. I remember in 1870 diamonds cost £14 a carat. The price has fallen to £5, the result of too great a supply. But a really magnificent jewel, no matter whether pearl or diamond, always retains its value, and a collector, if he chooses to invest large sums to the purchase of the best article, can always sell at a profit. One of the greatest difficulties in dealing with diamonds is the operation of cutting, which needs an apprenticeship of a lifetime to make an expert. There are a few good cutters in the world, and there is actually only one man who can drill a diamond."

IN SOUTHERN SEAS.

Mr. Streeter and his son, Mr. George Streeter, who, although young has himself been on the pearling grounds, visited New Guinea, and explored Cape York. He gave an account of the Streeter pearl fleet which is at present at work on the north-west coast of Australia. The fleet numbers thirteen decked boats, including a couple of 150 ton schooners, "Our boats have long been pearl prospecting in North Australian waters, and only recently they visited the deeply indented shores of southern New Guinea. There they discovered shells in abundance, but the unhealthiness of the climate wrought sad havoc among the men, who died of a disease peculiar to these Southern waters. The disease is a sort of heart complaint, known as beri-beri. So we withdrew the boats from such dangerous regions. I am most proud of the organization of my pearling fleet, but the expense has been enormous. Perhaps I have spent £10,000 up to now, and I am just beginning to secure a return. Do not imagine that pearl fishing is holiday work. It is like any other commercial enterprise, and needs steady application, great industry, untiring efforts, and readiness of invention to reap any substantial reward. Singapore is nominally our headquarters, and the operations are under the control of three Europeans, I call them 'my boys'; one is my son, another is Mr. Haynes, and third is Mr. Chippendale. They are the white bosses, and my most trusted and devoted servants. They have under their command about a hundred and fifty Kanakas and Malays, of whom thirty or forty are divers. For each one of these I gave a guarantee to their respective Governments, engaging to pay them a fixed wage. Each diver has £2 a month, and an allowance of £13 upon each ton of shells which he brings up. The shells run 2,400 to a ton."

HOW THE FISHERY IS WORKED.

Mr. Streeter then showed me some shells which had recently arrived about ten inches in length by eight in width. "You will see," he said, "by these perforations in the back how many enemies the pearl oyster has," pointing to the back of the shell, which was much honeycombed. "If they succeed in boring clean to the flesh it is all up with the oyster. The theory of the pearl is that some foreign substance, a bit of grit or shell, finds its way within the harness, and the oyster, to avoid the irritating friction begins the process of pearl manufacture by the peculiar secretion. The pearl

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is generally found in the beard. I need not tell you that the shells are highly valuable articles of commerce. When the opener has passed his hands in to feel for the pearl he throws it to the cleaner who does his work, the shells are packed up in hogsheads, and when they arrive in London they are sold by auction in Mincing-lane to go to the manufacturer, for the shell has taken the place of ivory. The pearling season lasts from March to the middle of December, for in the summer months the hurricanes render their fishing impossible. The plan of operations is something in this wise: the fleet is distributed over the fishing grounds, and one or two of them see to the supply of fresh water and stores. The mother ship generally lies at anchor in the bay, and the small boats leave her every morning to go to their various grounds close by. At night they return with their cargoes. The decked boats go further afield, and bring the results of their labor at longer intervals. At certain times the mail steamer which calls at Freemantle ships the cargo which comes home, the pearls themselves being sent through registered letters, and passing through post."

THE DIVER AND HIS DRESS.

"A year or two ago the divers suffered great hardships, always going in naked, when they could not stop beneath the water for a longer period than a minute and a half. The apparatus we use is made by Mr. Heincke, and of these we have about twenty, each costing £130. The dress is not like that we see used on our own shores, comprising only a headgear and a breastplate, the legs being free, but the natives like it very much, for they are able to stay under far longer, about two or three hours. I have never lost any men through sharks; they don't seem to like niggers; but the divers, by a trick which they have learned, when they see a shark approaching, squeeze out some air, which throws out a most vivid stream of air bubbles, effectually frightening the beast away." Each diver has a tender, that is the man who directs the rope, and four pumpers, so that the working gangs are divided into quintets.

In one of Mr. Streeter's rooms hang a dozen imposing rolls, each of them worked by a string. Pulling the one marked Australia and South Pacific, the whole of that immense area was placed before my eyes by his son. Upon these trackless oceans, studded with a million isles, many of them laid down upon the chart without much pretence to accuracy—for the reefs and the sounds and the channels are always shifting—among these tropical wastes Mr. Streeter's brave little fleet has found its way, and the King of Pearls, although he has never visited foreign parts, is able to follow the various routes which they have adopted, and these are marked by tortuous lines on the map. Somerset I was informed was played out. Somerset lies to the north of Carpentaria, and sure enough there was the mark on the map.

THE LATEST NEWS FROM PEARLING GROUNDS.

"We are working," says Mr. Harry Streeter, in his last letter from the fisheries, which was read to me, "with small open boats and two four-ton ketches, which are perfect in any weather, only coming every second day to give up their shells. The only flaw in our arrangements is that the open boats are too small for the work; in case bad weather sets in, they get too leeward, and have to be out in a heavy sea and take their chance of swamping, while the ketches, being decked in, ride like ducks. Many a time after a hard day's work, and all hands thouroughly tired out, we have had to get up anchor and make sail after some poor beggar going out to sea, and not able to reach the ship. If a boat sinks the pump goes down with her, and there is a dress lost. One of the boats has sunk twice,

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but luckily close to the ship, and we have sent a diver down and got everything up without damage. At present we are under the lee of an island, and as the wind blows from south to south-west every night we lie as snug as possible; but when the first came down we were lying in the middle of the gulf—blowing a gale of wind every night, and dipping bows and stern ports under, though she had forty-five fathoms of chain out, and the anchorage was only eight fathoms. I would n't go pearling with Queensland niggers on any consideration. You have got to ride for a couple of months upcountry to catch your men, and after you have got them they must be watched night and day to prevent them 'putting.' Then every one on board literally pigs it out during the time they are on the grounds, having to sleep and eat on deck, no matter what weather. Fancy fifty niggers, six white men, and 50,000,000 cockroaches all chumming together, and all living on damper and tea. That's what it really amounts to. The men, who receive a handsome percentage, work like demons if we say nothing to them, letting them go out when they like and return when they like, and I assure you they are out day break and not in till seven o'clock at night. Your experience of Torres Straits will tell you that if they go down there for three hours a day they think they have done well. Good eyesight and confidence are all that are wanted for apparatus-diving. All there is to do under the present system is to count the shells on arrival. This takes from an hour to an hour and a half each morning. Chips, myself, and the mate open them. This takes from two to four hours, depending on the number of the shell, and then they are washed and put in the sun to dry for twenty-four hours. The shell is broken into two pieces, the inside edges clipped, and then packed away in hogsheads. Though the shells run so small here, we have close on twelve tons in nine weeks, and if they had run the average of West Australian shells—1,200 to 1,500 to the ton—we shold have close on twenty tons on board, as to make our present amount we have over 25,000 shells on board."

THE MYSTERIOUS PACKAGE AND THE FADED MANUSCRIPT.

Most of us have read Mr. Haggard's vivid account of the search for and discovery of King Solomon's mines, in which three adventurous spirits guided by a faded map done in human blood on a fragment of linen 300 years old set forth to discover the vast treasure which King Solomon was supposed to have hidden in the bowels of a great range of mountains in mid-Africa. How they found it and what happened we leave our readers to find in the book itself, sufficient is to say that the story is one of the most fascinating pieces of fiction that have appeared for many a long day. I have said this because Mr. Streeter, who may certainly be considered the greatest expert living in diamonds and precious stones, mentioned the book to me, affirming that wherever Mr. Haggard got the foundation for his story, he would almost be inclined to accept some of it as sober facts. You would think me a Munchausen were I to tell you of the strange applications which are made to me to provide funds for such expeditions. If you have ever walked through some of the great picture galleries of Florence, you will notice that all the women are painted with most magnificent necklaces of pearl. What has become of them? Where have they gone to? People do not wantonly destroy such things. If you gave me an order today for a pearl necklace to cost £40,000, it would take me a year's careful inquiries to fulfil your demand. It might take even longer, for I do not know where such a one exists. Of course, I should have to collect the pearls singly from all quarters. "Every mail," said Mr. Streeter, "brings me strange documents from remote and forgotten towns of south America, from the east and from the west, from all quarters of the world. Now, here is one," handing me a small parcel bearing the Spanish postmark, wrapped in brown grass paper and carefully tied up at the ends.

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"You map open it and see for yourself what it contains." I carefully untied the mysterious package, wondering what riches it would disclose. The riches were but on paper. Nothing more than a tracing, showing a river, a few villages dotted about on each side, and a few sketches which showed the topographical features. Besides the thin tracing that cracked in my hands there were numerous writings on thin foreign note-paper. "That came to me a day or two ago from a correspondent of mine in remote Spain. The plan shows the route to a long forgotten mine which my correspondent has discovered. Here you see"—reading from the faded manuscript—"are accurate and minute directions for approaching it, with close and detailed descriptions of the surrounding country, the rivers and the mountain passes, the character of the people, and the whole story of the mine. You need not trouble to read it, but the legend may amuse you."

A SAPPHIRE RIVER.

"I have projected many expeditions," said the King of Pearls; "some have been successful, others not. It is a great gamble, and one must take the good with the bad. Men come to see me here fron all parts of the world with their schemes; some I take, many I reject. It is a hazardous business, for one has to trust to individuality. When a man comes to me with a proposition to work a mine, in Mexico say, I try to read his character in our talk, and if I like him and he produces details that seem to me credible, if he has character and decision—he is generally well travelled—we hit it off well enough. Sometimes they go, and for a time all is well, then they disappear for ever from view. In 1869 I sent out Professor John to the Diamond Fields in the first rush, and the party of three bought three claims for half a guinea a piece. For one reason and another they worked for awhile and then sold out. Since then these same claims have produced millions. That was a big slice of bad luck if you like. In Ceylon I have taken rivers for cats-eyes and sapphires. I once tried Cashmere, but could never get a concession, though the Rajah sent my wife the handsomest shawl I ever saw. I have sent expeditions to the Sulu Sea, and all round the coast of Australia. I have now a party working a Brazil river for gold and diamonds. Then, just before the Burmese war broke out, I was negotiating with Theebaw for a concession to work the famous ruby mines which lie above Mandalay. We have plotted out the road, for which we were to receive (paying £20,000 for the mine concession) eight miles on each side of the Irrawaddy, along which the road lies."

PLUMBAGO USED AS A MORTAR AND AS A DYE IN CHINA.

Recently we have been able to collect a great deal of information regarding graphite in its various forms and the multitudinous uses to which it is applied, and now we have a very curious contribution to our knowledge from China. It will be seen that, by the celestials, a special form of graphite, associated with coal and bitumen, but confounded with neither by the astute Chinese, is used when mechanically united to lime as a plaster or mortar and with coal fibres (also mechanically), so as to form a permanent dye. Here are two new uses for the extraordinary substance which aids in the manufacture of steel ordnance, is itself manufactured into pencils, and is good as a lubricant and fire-proof paint. It was formerly valued as a medicine, and the writer of the very interesting account we quote has found the form of the ore he describes useful in surgery as a styptic and a substitute for substances usually employed as "dry dressings."

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NOTES ON THE SO-CALLED "BLACK LIME" OF CHINA.

The following note on Black Lime, by Dr. A. P. Peak, Tientsin, appears in the Customs Medical Reports:—

This substance is made by Dr. Williams to be "a kind of bitumen," and as it has not been mentioned by any other writer with whose pages I am familiar, possibly the correction of this mistake and the noting of two uses to which it is put by the Chinese may prove of interest.

A suspicion of its bituminous origin might arise from the facts that at some places there are found traces of petroleum in connexion with the coal measures near which it is found, and that water in which it is macerated sometimes shows an iridescent film upon its surface. The substance in question is, however, *amorphous graphite*; and although it is mined in localities near the coal beds, the Chinese themselves insist that it has no connexion with them. The provinces of Chihli and Shantung are mainly supplied from mines in the foot-hills of the range bounding the great plain on the north-west, and much of this material is shipped from Liu-li-ho, whence large quantities of lime and coal are also forwarded, this city, situated at the head of one of the affluents of the Peiho, being the distributing point for a large mountain region. Near Liu-li-ho surface indications of petroleum seem to abound.

One of the uses before mentioned is its mixture with lime, to make a very hard and durable plaster, used in situations that are exposed to the weather. Because of this association, the Chinese call this "lime" like the other, although, as they say, it has not the fiery principle of the white lime.

A peculiarity of this graphite is its avidity for water, not from chemical affinity, as with lime, but from its great absorbent qualities. The crude graphite, in lumps as it comes from the mines, when exposed to contract with water, at once becomes permeated by it, and falls into powder. In this state the particles slide upon each other with the greatest ease, giving that lubricating quality which is characteristic of graphite. When mixed with freshly slaked lime, graphite in this state can be very thoroughly incorporated with it, each one of the finely divided particles becoming imbedded in a matrix of lime, and by laborious working and pressure, as the mortar sets the mass can be so consolidated as to make, when hardened, one of the best and finest grained mortars known, specimens of which can be seen in the so-called "chunam" roofs.

The superiority of this mortar is due solely to the physical character of the little knife-edged, microscopic fragments of carbon; and yet, strange to say, the use of silicious sand in mortar does not seem to have commended itself to native builders. I have never been able to get one who was not familiar with foreign ways of building to acknowledge its utility. True, it is somewhat difficult to obtain on this great alluvial plain; still, where it can be had, so far as I know, loam is used in preference.

To pass to the second economic use of graphite; this is the curious one of dyeing cloth. The cotton garments universally worn by the middle classes are coloured with the substance. The cloth is soaked in a hot, aqueous mixture of graphite, in which there is a little glue; it is then placed on a stone and mauled with wooden beaters; again immersed and again beaten, the process being repeated many times with each piece, until the cloth assumes a deep and uniform tint attained by thus mechanically forcing the fine particles of carbon more and more deeply into the fibre of the cloth.

I have rarely seen a more beautiful object than fibres scraped from the cloth, loaded with brilliant, razor-like fragments of carbon, like diamond dust, especially when viewed in glycerine under a $\frac{1}{8}$ immersion lens. It is difficult to believe that such beautiful transparent objects make up in mass the dull opaque plumbago.

This process of dyeing, if we may call it so, I believe to be unique in the art as practised at the present day. The colour is, of course, indestructible by

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the sun or chemical action, and can only be discharged by thorough and repeated washings. Hence it makes a very satisfactory and permanent colour for Chinese garments, and approves itself to the utilitarian native mind, as witness its universal use.

Graphite is abundant, and sells in the market here for 5 cash a catty; yet these are all the industrial uses of it, so far as I know.

Lead pencils, crucibles, stove blacking and lubricating are not yet achieved by means of it.

Oddly enough, the Chinese have not thought of using it in medicine. Yet the great hygroscopic qualities of the fine, soft, velvety powder, which may easily be obtained by levigation, indicate a direction in which it may advantageously be employed.

In such affections as require dry dressings, *e. g.*, moist eczemas and purulent otitis, it could not fail to be of service. As a styptic it is of considerable value. I have found that a combination of 3 parts of graphite, 2 parts of resin, and 1 part of acacia, by weight carefully triturated, possesses very marked hæmostatic properties.—*Hongkong Daily Press.*

SEED-PEARL SHELLING AT BATU BATU.

The following, from the *North Borneo Herald,* will be interesting to our readers. The pearl shell referred to is the species found in Tumblagam Bay, near Trincomalee, the large thin shells of which are said to be be used by the Chinese as substitutes for window glass, and which are put to artistic use, small pictures being painted on them, having all the effect of transparencies:—

The prominent point of land called Batu Batu jutting out into Padas Bay is now the centre of much activity, and many refugees from the dismembered kingdom of Brunei have made it their home. Constant feuds, intrigues and misgovernment have rendered life and property insecure in Brunei, and gladly have our immigrants exchanged the red banner of Brunei for the protection afforded by the ægis of the Royal Chartered Company.

Most of the immigrants come from Brunei, others hail from Labuan, Lawas, and neighbouring rivers. The roving adventurers who trade from port to port along these coasts do a good business with the Muruts who bring down jungle produce, for which hitherto, there was no market, and the newly-arrived "horny-handed sons of toil;" immediately find employment in seed-pearl fishing, boat-building, cutting plank and spars for boats, planting paddy on the Linkongan, Lukutan and Sipitong rivers or working sago on the Padas or other rivers that debouch into Padas Bay. The gard wood of Batu Batu and surrounding country have for many years past been well known in Labuan, and within the last month the Labuan Government has been supplied from Batu Batu with spars of the famous "Bintangor" wood for their new flagstaff. The deposits of coal at Bukit Naloyan are as yet quite undeveloped, and samples have been sent to the Indian and Colonial Exhibition, London.

But the principal occupation of the immigrants is in gathering the seed-pearl shells (*placuna placenta*), called by the natives "seleesip," which abound in Padas Bay. A flotilla of twenty or thirty boats roams about the bay, generally together as in herring fishing, in search of the oldest shells and when these are found to be too young the boats move on to another bank. It is a rule with the fishermen always to throw back the young shells into the sea, but if a shell has been opened and the oyster destroyed it is not thrown back, as it is said that the dead shells kill the live ones. These shells pay the fishermen in a threefold manner. First, the shells divested of the oyster fetch in Singapore from $1·80 to $2 a picul, then the oysters dried in the sun only (not salted) sell for about $4 to $6 a picul in Labuan, and thirdly, the seed-pearls are sold in Labuan at one Mayam $1·80, one Basing=

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10 Mayams $80. When a boat comes in, the load of shells is turned out on the beach. Then each fisherman gets two buckets, these are made of the sheaths of the nipa palm, and with a sharp knife manufactured for the purpose, the shell is opened and the oyster is cut off within ¾ of an inch from the hinge of the shell. The oyster falls into one bucket, and the part clinging near the hinge is scraped off and falls into the other bucket. It is this little bit that contains the seed-pearls, if any, and they are carefully extracted. The oysters are laid out on mats to dry in the sun and sold in Labuan.

A great number of the seed pearls are disposed of in the village at Batu Batu. When the fisherman buys his few necessaries at the Chinaman's shop he pulls out his little bundle of seed-pearls and pays in that currency, the Chinaman making a good thing out of this transaction. These seed-pearls are not much valued in Europe, but in China they are used as ornaments or pounded into medicine and the shells being thin and transparent are also a substitute for window glass.

There are four principal banks of seed-pearl shells in the shallow part of Padas Bay, in a ripe state for working operations, and there are some more where the shells are still growing; these are forbidden ground until such time, say another six or nine months, when they shall have attained maturity.

The scene on the sand or mud banks in the bay is lively, men, women and children up to their knees in water gathering the shells that are imbedded. They seem very busy withal cheerful and chattering and seem glad to see the Government boat with the British North Borneo Revenue flag flying aft, picking its way among their boats. As we pass, the women playfully throw a few shells into our boat for luck; further on may be seen, on sticks fixed on the bank, some white flags to keep "evil spirits" away.

The collection of the Royalty on the seed-pearls exported was a somewhat difficult nut to crack. The Regulations said that 5 per centum *ad valorem* was to be collected.

Mr. C. A. Francis, the energetic officer in charge of Batu Batu found that the seed-pearls were so easily hidden away that the revenue therefore amounted to very little. A tide-waiter was sent to his assistance, his duty being to go about among the people, find out what pearls had been procured, and to search them. The first month only brought in some $6 revenue, and as his pay was $12 a month, the result was disappointing. He searched the fishermen but found little or nothing, all the while knowing well that they had extracted many seed-pearls from the bivalves. Little boys showing their bright teeth look up with their laughing eyes, the picture of innocence, and all the time concealed little packets of seed-pearls between their toes, but native boys can do anything with their toes from holding a nail straight with them while hammering it into a plank to combing their hair. Of course the natural bashfulness of Province Dent officials forbad a close examination of the ladies, and the result was that this mode of collecting the Revenue was a dead failure.

It was now suggested that $2 should be charged on every boat, but this plan was found to be impracticable as fifteen or twenty persons would crowd into a large boat so as to evade the tax. At last the fishermen themselves were consulted in the matter, and they voluntarily proposed that a head tax should be levied on every man, woman, and child who were employed in fishing on the banks. The old men said the young people gathered the most shells as they could stand longer in the water than they could, as it gave them cramp to be too long in the water, and that it was quite fair that the young ones should be taxed.

The payment of $1 per head per mensem was agreed to by all, and the first month *i. e.* December 1885 brought in a head tax of $81, whilst the month of January 1886 yielded a revenue of $95, and people pay this mode of taxation cheerfully and rapidly.

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In the Inland Sea at Kwala Penyu, in Province Dent, there are shells of the same description, the only difference being that they do not breed seed-pearls, and it is said that in former years they did not produce any. The Assistant Resident has now sent away several hundredweights of Padas Bay shells for deposit on these banks, believing that the admixture of the breeds may remedy the defect in these barren oysters.

The seed-pearls shelling is as yet in its infancy, and it is expected that a large population will settle at Batu Batu to this and other lucrative occupations. As Julius Cæsar is said to have conquered England for the sake of her pearls, so let us venture to hope that a similar but less demonstrative invasion will take place in Province Dent.

SPINEL AND GOLD AT WARRIAPOLLA.

From Mr. Fraser of Warriapolla, near Matale, we have received the following interesting letter:—

"Warriapolla, Matale, 27th Jan. 1886.

"Dear Sir,—It is curious how a coincidence takes place, and I now write to tell you that it was not until today, when I came in with a collection of some very peculiar and pretty coloured quartzy lime rock (of which I had for long known the existence, but had only regarded as a mere freak of Nature, and had laid down as the foundation of some hundreds of yards of road) for the purpose of forwarding these stones to some friends. I happened to take up the *Observer*, and my eye rested on the article you give in your edition of the 26th January, mentioning Warriapolla as a spot where spinel had been found. It abounds here in large quantities, and until today I never knew it had any value. Once I found a piece of the size of a robin's egg and I asked a *jeweller* in Matale (if you can call these people by that *term*) what it was, and he told me that it was a ruby. My weak mind was unable to accept this statement, not having seen a blue ruby. I also found red crystals imbedded with the blue, but these I took to be the garnet—and so with no more thought on the matter, the coolies continued building yards and yards of roadway with this sparkling stuff, and it has been all covered over with metal and gravel and lost to view. But the locality from which this bedding stone was gathered will still be found to abound in these bright blue crystals if they be searched for.

Mr. W. Tytler first noticed the peculiar crystal formation as of value when he was staying with me, and he showed me several other places where he thought precious stones must have been collected on the estate. A Sinhalese tells me now that I am reclaiming land which used in former days to be a rich source of precious stones to the natives who, after heavy rains, used to wash the sand of the river close to its banks, and they undoubtedly did obtain something, for otherwise I should not possess, as I do at the present time, a small packet of gold-dust, which years ago was washed out of the sands of the Wariyapola-oya, and sent to my father as a proof that gold existed in Ceylon, and on Warriapolla also. I am told by natives that this very portion of the river of which I now speak of was a continual scene of gemhunters, and I myself have seen Moormen amusing themselves, as I thought catching fish. They may have found some other kind of fish, let us hope they did; for, at least, that, for a time, would keep them out of mischief.—Yours faithfully,

ROBERT H. FRASER."

It is no new experience, in mineralogical formations, that gems should be found associated with gold. So it was in Australia, and in that country roads were made and streets paved with rich gold-bearing quartz, a full generation before the Laird of Warriapolla indulged in the luxury of bottoming his roads with spinel-bearing limestone, including probably, "full many a gem of purest ray

serene." Mr. Fraser does not say how he ultimately disposed of that gem as big as a robin's egg. If perfectly translucent, uniformly blue and flawless, it would, probably, when properly cut, have been deemed as valuable as a red specimen of the same mineral, to which the name spinel ruby is given. Mr. Fraser, like Mr. Kellow, and probably a good many others, will now know what blue crystals in limestone mean, and will keep a good look-out for large clear specimens of the gem, for gem it is, only second in value to the sapphire, when of equal purity and size. Of course, such gems are more easily got at in the beds of streams into which they have been washed than in the matrix, which must be mined and carefully broken up. On the other hand, regular mining may result in much larger and more regular finds of precious crystals, and, where the latter are not precious in the technical sense, their presence in quantity ought to give value to the stone as a marble. We mean to see how a hand specimen will polish, and we are sanguine that it will come out well. The result will be stated. Much of the country around Kandy, such as Haragam and the valleys of Dumbara and Matale, doubtless owe much of their fertility and probably a good deal of their insalubrity (for which Haragan and Rajawella were at one time notorious) to the large prevalence of crystalline limestone, and the soil and gases which result from its decomposition. Careful examination in the light of Mr. Kellow's recent discovery and Mr. Dixon's previous notice of the Warriapolla and Watagama formations, will probably establish the fact that a much larger proportion of our mountain limestones than any of us imagined are valuable as gem-bearers, apart from their varying, but in some cases rich, proportion of carbonate of lime. Of course, it is not gold which gives the beautiful golden colour to iron pyrites, but it is a fact that true gold is not unfrequently associated with iron pyrites. It is not our limestones alone which demand the careful examination of a mineralogist, such as is now employed by the neighbouring Government of Madras, but our quartz rock, some of which, especially on Mr. Blackett's property in Dolosbage, look very encouraging. Now, that it would seem that gold in really paying quantities is being mined close by us in Southern India, it would be well that the similar question in Ceylon should be settled once for all, even if in a sense the reverse of the existence of paying quantity. Our mountain limestones, which differ from and are economically less valuable than coral and shells, in consequence of the sometimes large amount of magnesia they contain, associated with carbonate of lime, are usually described as "beds overlying the gneiss" which is our principal primitive formation. But the truth seems to be that, very frequently, long veins of the limestone underlie the top ranges of gneiss, cropping out amidst the valleys and "foot hills." This will become apparent, on reference to Mr. A. C. Dixon's account of the principal dolomite beds or veins, which intersect the mountain system of the interior of the Island:—

Dolomite beds.—As far as I have been able to trace them during the time at my disposal, I find that these beds run through the gneiss in a somewhat parallel direction, striking generally N. W. by N. to N., and having various angles of dip from 10° to 40°.

I have indicated their position on the map. The first is one which outcrops a few miles this side of Balangoda, and runs N. N. W., occurring again at Hanuwala.

The second runs through Dolosbage and Maskeliya; probably the bed occurring at Bilul-oya is continuous with this.

The third outcrops under the Great Western on the Great Western estate, and is continuous to the N. N. W. with the Wattegoda and Medakumbura dolomites, and probably also with the beds at Gampola and Kurunegala. A subsidiary bed—or it may be an outlier of this—occurs near the Pussellawa resthouse.

The fourth bed outcrops largely at Wilson's Bungalow, Glen Devon, Dumbara and Matale.

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The fifth occurs in the Badulla districts. As in the gneiss we have a great many varieties, so also in the dolomites. They all contain carbonate of magnesia, which varies from 1 to over 40 per cent.

These limestones are very valuable for estate purposes as well as for building stone and building lime.

In colour they vary much, dependent on the numerous accidental minerals that occur along with them. Thus the specimens from Wilson's Bungalow are very dark; they contain pyrites, philogopite, chlorite, epidote, &c.

A dolomite occurring at Wariapola on the Matale railway contains a large amount of blue spinel. Some of the crystals of these dolomites have large facets, others small and of a granular texture. Many contain white translucent siliceous grains not easily distinguished.

A beautiful example of limestone of a somewhat peculiar tinge, due to the metal chromium, occurs beyond Balangoda, and often contains fine specimens of crystaline biotite—a magnesian mica. This limestone shews a very peculiar and characteristic weathered surface.

As we are writing, the following letter from Maskeliya reaches us with a small specimen of rock, similar to the Ambawella rock, but differing in the prevalence of small, white crystals contrasted with the blue:—

Theberton, Ambagamuwa,* Jan. 27th, 1886.

Dear Sir,—I send by this post a small sample of my limestone, as I see by the account you give in your issue of the 26th inst. of the stone found by Mr. Kellow, that mine is of the same description. I have it in my lime reef, red, blue, green, violet and black, at least some of the limestone has black crystals the same description as the others in every way except colour. My children have found quite large pieces of red spinel which we have taken no care of, as Mr. Dixon told us they were only spinels and of no value. I have at times come across from the limestone really beautiful pieces full of these blue and violet crystals and other colours, but blue is the most abundant. Mr. Dixon did not think much of it and said they had something to do with copper and iron.

T. J. GRIGG.

P.S.—One of the boys smashed the other day a red spinel he found in ½ inch square as he thought it was no use. I firmly believe if we had a *good man* to make a survey etc. in Ceylon, something would turn up of value to the Island.—T. J. G.

It is quite true that ordinary spinel is not of much value, but large, perfect crystals, especially if of ruby red colour, ought to be preserved and their value ascertained.

ROMANTIC HISTORY OF A CEYLON GEM.

With regard to the extract given below from the Adelaide *Evening Journal* of June 29th, we have to say, that, like the king's jeweller, we never before heard of white spinel, and that, if the stone is spinel, the estimate of £23,000 as its value is simply outrageous. The stone is probably a "white sapphire." Can any correspondent throw further light on the subject? We find Captain Honner's name mentioned in Cordiner's account of the advance on Kandy in 1803. He led the Grenadiers of the 19th in the successful attack on the Kandyan "battery" at Giragama, and we suppose he was in command of a party of 300 of the 19th sent from Kandy to meet Col. Barbut and Muttuswami.

We have been furnished with the history of a very rare and brilliant specimen of Oriental white spinelle, to be seen in Mr. J. M. Wendt's case close to the entrance in the main building. The gem was presented to Mr. Robert

* Post town in Ambagamuwa, but dates in Maskeliya.—ED.

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Honner, late Major of Her Majesty's 19th Regiment of Foot, by Boedoe Swamie,* King of Kandi. In the year 1803 the Colonial Government of the Island of Ceylon, through the intrigues of Mr. North, General McDonald,† and the Adjaars‡ in connection with the pearl fisheries, declared war against the King of Kandi. An army was marched against his capital, which was ultimately attacked and taken. The Government then determined to place on the throne the lawful sovereign, Boedoe Swamie. Colonel Barbut was sent to Jaffra§ for him. It was reported that the Kandians would oppose his passage at a river three days march from Kandi, and that the deposed King had taken up a strong position on the river with all the forces he could collect. Major Honner, then a captain, was ordered on March 20th, 1803, to move with 300 men and three fieldpieces to open a communication with Colonel Barbut, to disperse the enemy, and escort the Prince to head-quarters to be crowned. Captain Honner marched according to orders, dispersed the enemy, received the Prince from the hands of the colonel, and brought him safely through all dangers to Kandi. They halted about 2 miles from the city to prepare for the Prince's entrance. The following morning Boedoe Swamie presented the stone which is the subject of this history to Captain Honner as an acknowledgment of his services and bravery. At that time it was set round with ruby spinelles in the Eastern style, and was worn as a turban pendant. The fate of this Prince was most unfortune. Not one of his people would acknowledge him, and on June 25th, when the small British and Malay garrison left to protect him were hard pressed and surrounded by 50,000 of the enemy, representations were made to Major Davie, who commanded the Prince's guard, that if they surrendered Boedoe Swamie, who would be treated with great kindness, they would be allowed to march to Colombo unmolested. The Major consulted his officers, and explained to the Prince that they had not sufficient power to protect him any longer, to which Boedoe Swamie exclaimed—"My God, is it possible, and can the English triumphant arms be so humiliated at present as to be afraid of the menaces of such cowards as the Kandians are?" The Prince and his seven servants were given up to the Kandians. He was immediately impaled, two of his servants were beheaded, and the rest were hanged to a jack-tree. Then followed the massacre of the Europeans. The sick were tied two together and beaten to death with sticks, and the able-bodied soldiers were hacked and beheaded and thrown down a deep hole on the hillside, dead and alive. The Major and another officer were spared for a life of torture and sickness. The assistant surgeon alone found his way after many days to Colombo to tell the sad tale. In the course of time Major Honner carried the gem to London and first showed it to Messrs. Randle and Bridge, jewellers, near St. Paul's, who bought the gold and the rubies that surrounded the stone. They introduced Major Honner to Mr. Lowrie, who lived near Finsbury-square, a professor and lecturer on mineralogy, who informed him that it was a white spinelle of great value. Mr. Lowrie tested it in various ways, but what seemed to fix his opinion more than anything else was the fact that he was unable to scratch it with the hardest topaz in his possession, though it made an impression on the topaz. In the same year it was shown to Mr. Hawley, of the Strand, jeweller, who kept it for two days and offered to purchase it. It was then taken to the British Museum to obtain the opinion of Dr. Köneg, the head of the Mineral Department. It was examined by him in the presence of Dr. Walter, Dr. Ashburner, Mr. Hawley, and Major Honner, and many others. Another stone, supposed to be spinelle, was produced by them, and at the advice of Dr. Köneg, the two were submitted to heat on the bars of the grate. The stone in question

* Muttuswami.—Ed.

† General MacDowall.—Ed.

‡ Adigars.—Ed.

§ Jaffna.—Ed.

remained on the bar some time quite sound and uninjured, whilst the other burst. A piece was then removed by the doctor with a hammer in the presence of the same gentleman in order to discover the cleavage. Both these experiments confirmed the opinions already expressed that it was a white spinelle. It was then taken to Mr. Sowerby the celebrated mineralogist, whose opinions agreed with Dr. Köneg and Mr. Lowrie. In the same year it was submitted to the opinion of many well-known mineralogists, the majority of whom pronounced it spinelle. Mr. Macholian, of Lisbon, wished to become a purchaser of it, and also a French gentleman, but their offers were refused. About this time Major Honner went to settle in Tasmania, and left the stone in the care of his brother-in-law, Sir Charles Forbes, Bart., of the firm of Forbes, Forbes & Co., City of London. When he returned home he was engaged in the Portuguese service, and took no steps to dispose of the stone until about 1843, when he was in Paris, and thinking that Louis Philippe, King of France, might like to be possessed of so rare a specimen, offered it to him. Louis Philippe was willing to become a purchaser if Major Honner could obtain a certificate from the King's jeweller stating it to be spinelle. Accompained by Mons. Carson, Gresor de la Couronne, he waited upon Mons. Basset, the King's jeweller, who, much to their astonishment, owned that he never saw a white spinelle and could not tell the character or properties which distinguished it from other stones. For some short time it was in the custody of Colonel Augustus Honner, C. B., brother of the Rev. A. Honner, who obtained some valuable confirmatory evidence. At the death of Colonel Robert Honner, a few years after, the stone came into the possession of his widow, who at her decease gave it to the Rev. A. Honner in preference to his eldest brother, Major-General Sir Robert William Honner, K. C. B. The gem weighs 285 grains, has a specific gravity 3·56, does not exhibit electricity when heated, does not refract double, and has a cleavage peculiar to the spinelle. It is harder than topaz, but not so hard as sapphire. Its intrinsic value has been estimated at £23,000. The polarizing angle received from the surface is 32° or 31° 30′. In 1867 the Rev. A. Honner exhibited it at the Archæological Society in London, and was offered a very large price for it. The gem is supposed to have been cut 400 years.

REMARKS ON THE LATE MR. WM. STEWART'S PAPER ON GEMMING IN CEYLON.

(By a Sinhalese.)

Generally the adventurers are not the cause of immorality. Men who go to strange parts to make money and having that determination steadily in view do not generally misbehave. But it must not be forgotten that the Rodiya women do tempt these adventurers and rob them of their hard gains whenever they get an opportunity. This is one of the causes which has produced an improvement in the condition of this people of late years. It is not the Malays but the Moors who resort to Sabaragamuwa to buy gems, and the trade is completely in their hands. Bargains are made for ready money and not for cloth and salt. The author is treating of a time not within the memory of man when he mentions this kind of barter which has long since passed into history. The religious festival which brings together traders from all parts of Ceylon is the Perahera of the Maha Saman Dewala, which ceremony is not considered a Buddhist affair by orthodox Buddhists, but one pertaining to the worship of Saman. That the position of the people of Sabaragamuwa is so much improved that they can very well retain their precious stones, is all nonsense. All gems found everywhere in Sabaragamuwa are retained in

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possession only until a fair bargain is effected. Nobody in the whole district possesses a gem worth £50. Good and bad alike are sold to traders, and the money applied in most cases to advantage: such as laying out on interest, buying lands, building splendid houses (in a few cases) and the like; in some cases the money has demoralized the people and they have become drunkards and exchanged a life of labour and industry to idleness and profligacy. Those who were in the habit of drinking arrack betook themselves to more costly liquor; and one headman has been nicknamed "Gin Mohottala" by reason of his partiality to the Dutch spirit.

Large rubies are now very scarce. Recently one was found worth £500, one of that value has not been heard of for one-fourth of a century. Marco Polo mentions that the King of Ceylon of his day had a ruby of the size of a man's arm. In the time of Governor Imhoff, a chetty physician found a ruby in Sabaragamuwa of the size of, it is said, a curry-stuff grinding-stone, *i. e.*, the smaller one of the two stones employed for the purpose. He cut it up into small bits and retaining the best portion wherewith to make his fortune, presented the Dutch Governor with 18 buttons set with the smaller pieces, which, though small, were the largest single rubies known at the time and of immense value. The Governor showed his gratitude by exalting the man to the rank of First Malabar Mudaliyar of the Gate. He is the ancestor of the present family of Ondaatjes. He is the grand-father of Dr. Quint Ondaatje, who is described by Alison in his History of Europe as "Ondaatje the great Democratic leader," &c.

[He was, like Francis, the author of Junius' letters, got rid of, by promotion. Ondaatje was made a Judge of the Superior Court in Java, and his descendants, a family of Wallers, were once well known in Ceylon.—Ed.]

THE GEOLOGY OF CEYLON: CURIOUS FORMATIONS ON THE NORTH-WEST COAST.

Mr. Haly's remarks on the breccias or conglomerates and the "undoubted fossil shells" collected by him on the shores opposite the principal pearl banks, with his reference to a large but unassorted collection of rocks, some of them anomalous, apparently in the Museum, suggest more strongly than ever, the desirability of one of the members of the Geological Survey of India being borrowed for the purpose of examining, mapping and reporting on the geology of our island. Indeed such a work seems as much a logical necessity as the connection of Ceylon with the grand trigonometrical Survey of India. It seems to be a received doctrine that a process of elevation from the sea is going on here, the beaches rising in compensatory proportion to the disintegration and degradation of the moutain tops, so that the balance is kept true and the area of land remains unaffected. Of course, the elevating process assumed is dynamic, the result of mysterious forces and not of mere accretion of material. Judging from some evidences, one might be lead to suspect rather a depression of formations near the sea-shore, or, at any rate, that the rate of the elevating process must be excessively slow. Looking at the mode in which sand and silt carried down by the Kelani are arrested and forced back into long and solid barriers by the fierce sea waves of the south-west monsoon, we can easily understand how the river mouth was shifted from the Colombo Lake to a point three miles further north at Mattakkuliya. On the other hand, we are not likely ever to forget the effect on our olfactory nerves of the offensive black vegetable deposit, some twenty feet deep, at least, which had to be removed before a comparatively solid foundation could be found when the Hunupitiya Mills were being erected in the Cinnamon Gardens. The vegetable matter was doubtless in the early stages of peat formation, but far less advanced than the peaty formation, at Muturajawela, on the north side of the Kelaniganga, which was and perhaps

still is used as fuel for steam engine furnaces. As the beach rose where Colombo now stands and the waters of the river were obstructed, they must have expanded until much of what is now the Cinnamon Gardens became a fresh-water lake. It does not seem as if even the influence of the tides extended so far, for between the snowy white, exquisitely fine cinnamon sand and the coarse brown sand mixed with black metallic particles of the sea-shore, there is not the slightest resemblance. In the case of the Cinnamon Gardens, beds of pure white quartz must have been dissolved and deposited in calm water. What the dissolving agent was and what the time required for the process are points on which we should like to have the judgment of experts. As also on the extraordinary differences of formation in limited areas. Much of the white cinnamon sand which lies over the surface like wreaths of driven snow, consists of perfectly loose particles with no sign of cohesion. And no wonder, for they are almost pure silica, over 98 per cent of silicious matter being obtained by Dr. Davy on analysis of this truly remarkable substance in which the finest flavoured cinnamon in the world is grown. This free, snowy white sand can be seen to perfection on each side of the approach to the new Lunatic Asylum, especially on the right hand side. But where carbonate of lime is present in sufficient quantity this substance can consolidate into a good hard sandstone. When the Rev. F. D. Waldock was superintending the erection of the Baptist Church in the Cinnamon Gardens, he was rendered very anxious about getting a good foundation, from what we told him about the immense layer of rotten vegetable matter which had to cut through when the Hunupitiya Mills, not a quarter of a mile away, were erected. In proportion was his satisfaction when not far below the surface he came upon a good, sound stratum of solid sandstone sufficient to bear the weight of any superstructure. Several feet of this formation had to be broken through in digging a well and also in making pits for the reception of trees in the grounds, and it is obvious that where sheets of this rock extend in unbroken expanse under the surface soil, they must form a great impediment to the thorough drainage of one of the most favourite places of residence in our expanding city. We should like to hear all that can be fairly inferred or guessed about the existence in such near contiguity of masses of vegetable matter, of comminuted quartz sand and the same sand re-formed into sandstone, while not far off there are elevations consisting of ancient granitic gneiss metamorphosed into comparatively recent laterite, most fertile in its soft state and excellent as building and road material in its more indurated and gravelly condition. Still more curious, however, are the formations on the shores of the north-west portion of the island. Here, at Colombo, as we go below the surface we come upon evidence of fresh water vegetation, with no taint of salt in the well water. In the Puttalam district, famous for expanses of black mud, the case is very different. Fresh water can be obtained only in the generally shallow surface formations. If these are pierced, the well-digger comes upon a stratum, yielding only brackish water which, however acceptable to sheep, deer and other animals, is not fitted for human use. Under such adverse circumstances of soil formation and in a climate where the supply of water in shallow wells is apt to become too scanty, the natives, at the suggestion of Mr. Lushington, the Assistant Agent of the district, have adopted the expedient of concentrating water from a surface well of large area into a storage well, properly protected, so that water may be available in seasons of drought. Mr. Lushington's interesting description of the curious formations with which he has had to deal and the expedients resorted to, in meeting the difficulties arising from the brackish stratum underlying the surface soil, will well repay perusal:—

Another matter which has occupied much of my attention during the past year has been the amelioration of the Demala hatpattu.

This is a subject in which, going outside the ordinary routine work, much good may be done by the personal interest of a revenue officer if he is pro-

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perly supported by the headmen. Unfortunately the Ratemahatmaya of the division is lazy and negligent, and takes but little interest in the welfare of the people.

"The first thing of importance was to try to improve the supply of good drinking water; and with this object in view I caused meetings to be held under the Gansabhawa Ordinance in all villages which contained more than five inhabitants, and in which there was no well, and got the people to bind themselves to dig wells by communal labour. Thirty-seven meetings were held, and before the close of the year twenty-nine new wells were dug, with the best results. I personally explained to the people how to contend with the difficulty of which they complained, viz., that most of their wells contained brackish water. This is due to a stratum of very brackish clay which underlies the whole of the Puttalam division and part of the Demala hatpattu.

This brackish stratum was probably the bed of a large lagoon, similar to the Puttalam lake: in the Puttalam district it is near the surface; in the Demala Hatpattu it is at some depth. When a well ran dry the people deepened it until they reached the brackish stratum, and so obtained brackish water. This mistake I pointed out, and explained to the people that they should never dig through the clay, but should rather increase the diameter of the well so as to increase its storage capacity.

"This system has now been followed in many parts, and a good supply of excellent water has been obtained.

"A very remarkable instance of this kind of work was carried out at Kuruvikkulam, about three and a half miles south of Puttalam, thanks to the personal libarality of His Excellency the Governor. In this place there is always a great dearth of fresh water, and the numerous coolies employed on the Palavi salt-pans had water taken in carts from Puttalam for their use. The village stands on a piece of ground rising a few feet only above the level of the lake, and just above the brackish stratum, and the water-bearing area is nowhere more than six feet in thickness. I had a deep well (a little over twenty feet) dug into the brackish clay; this was bricked up and carefully cemented to prevent the ingress of brackish water. This was intended to act as a *storage well.* A few feet from this a shallow well was dug in the surface soil, *sixteen feet in diamater* and lined with dry rubble. The fresh water collects in this well, but is rarely more than two feet in depth. A pipe was, however, laid connecting this well with the storage well, and a good supply of water was thus gained. Water is only drawn from the storage well, and so the shallow water in the larger well is not disturbed.

"This experiment has proved a success, and the pure water was a great boon to the numerous pilgrims passing Kuruvikkulam on their way to and from St. Anna's church at Talavillu."

One cannot but feel that the Ratemahatmaya, so unfavourably spoken of in this and other portions of Mr. Lushington's report, ought at once to be removed. It is most unfair to an energetic officer to have his efforts for the good of the people hindered by an unworthy headman of their own race. Then as to the geological question Mr. Lushington refers the widely extended lower stratum of brackish clay (clay impregnated with saline matter) to a lagoon similar to the existing Puttalam Lake—a salt water lake, in many places exceedingly shallow—from deposits of mud. If therefore, movements of subsidence are not to be taken into account, it follows that surface deposits are forming at a rapid rate and that in a period comparatively short in geological time, we may expect the Puttalam Lake and much of the shallow water in the neighbourhood will become land more or less firm, Kalpitiya (Calpentyn) and Karaittivu being regularly connected with the mainland. As regards the present, however, we find Mr. Lushington complaining of neglect of the wells by the people. Under the head of "administrative measures engaging attention" the Assistant Agent wrote:—

"The next matter which has engaged my attention is the *amelioration of the Demala Hatpattu*; and one distinct step in advance which has been gained

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during the year is the general, though not yet universal appreciation of the benefits of good drinking water. Twenty-nine new wells have been dug during the year, and in nearly all good water has been found; but it is difficult to get over the prejudices of an ignorant population. Some of the wells have been allowed to fall in through sheer neglect, while in one village I was told that the people *passed by* the well and went to draw water at their tank, because they considered tank water more 'tasty.' " This reminds us of what our late friend Mr. J. B. Moens told us of the people of Batavia. A canal, Dutch fashion, runs through the city, and, from the habits which the natives are allowed to indulge in, the waters are filthy to a degree which can scarcely be imagined. Much of the notorious unhealthiness of the capital of Java being, correctly no doubt, attributed to the use of such water for drinking as well as other purposes, the Dutch Government introduced pure water, and we saw rows of hydrants alongside the canal yielding uncontaminated fluid. A proportion of the people, however, who had "become accustomed" to the canal water and whom it had failed to kill, objected to the pure water as being wanting in *body!* Mr. P. A. Templer, commenting as Government Agent, on his Assistant's report, defends the natives in their preference for tank water. He writes:—

"Mr. Lushington has done good work in the Demala Hatpattu by substituting wells for the filthy puddles of liquid mud, upon which the people often have to depend for their supply of water; but he is sarcastic at the expense of those who find tank water 'more tasty.' Many intelligent natives are of the same mind, pronouncing the best well water to be insipid, and it is possible that the water of a well-filled tank, constantly exposed to the action of the sun, may be as free from impurity as that of a deep and shaded well.

No doubt, the thorough aeration of tank water may be an advantage, provided the tank can be preserved from pollution. But here as in India with reference to tanks, and in regard to the canal in Batavia, the natives are too ready to use the water for purposes of ablution and worse, as well as for drinking. Hence a large portion of the cholera epidemics so rife in India and no doubt much of the "fever" which desolates portions of Ceylon. Our own fear of any real inferiority in water from the shallow wells which Mr. Lushington describes would be its impregnation with decayed vegetable matter; but the settling process and the passage from ordinary to storage wells ought largely to cure this. It is very interesting to read of the measures taken to remedy the serious natural defects of the very curious geological formations which constitute so large a portion of the Puttalam district and of the north-west coast of Ceylon generally. Whence come the volumes of mud which have so rapidly raised and are still raising the coast land.

"Carried by currents in the Gulf of Mannar," must we suppose be the answer, and those interested in the Pearl Fisheries of Ceylon and India, especially the latter, could fervently wish that the currents were not so strong and constant and that they were consisted of pure sea water, instead of water laden with volumes of mud which while adding to the shore accretions of Southern India and Ceylon, prove fatal to millions upon millions of bivalves which would otherwise yield abundant harvest of precious pearls. The comparative success of the Ceylon Pearl Banks of Silavaturai is due to the fact that they are sheltered from the influence of the larger portion of the currents which impinge with such deleterious effect on the Indian pearl banks near Tuticorin.

GOLD PRODUCTION.—It is reported that the total product of gold in the whole world last year was 118,000,000 dols., nearly half of which was mined on the continent of America. The product of silver is said to be 94,000,000 dols., of which 76,000,000 dols., was produced in that country. The grand total of precious metals was, therefore, 212,000,000 dols., an increase, as compared with the three preceeding years.—*Journal of the Society of Arts.*

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GEOLOGY OF CEYLON.

A correspondent, evidently a new arrival, asks us about a work to consult on the geology of the island. He is specially interested in the Jaffna Peninsula, where red soil resting on a coral base has puzzled so may observers. Our correspondent has a theory as to the origin of this soil, which we shall not anticipate him in stating. It differs from received opinions. We must ask our corrspondent to accept a reply through the columns and the *Observer*, which may be of some use and interest to others also.

There is no separate publication on the geology of Ceylon, and we can but repeat the hope so frequently expressed by us, that ere long a member of the Indian Geological Survey—one of the most extended and most complete in the world, and the results of which have been embodied in three separate manuals, the latest of which, on the gem minerals, has just reached us,—that an officer who has gained experience in the course of this survey may be borrowed to examine a report on the geology of this island.

The first real attempt to describe the geology of Ceylon was made by Dr. John Davy, a brother of the celebrated philosopher, Sir Humphry Davy, and himself an accomplished scientist. He served here on the medical staff in the early part of the century, and embodied his observations on our rocks and minerals and mineral waters in a paper contributed to the transactions of the British Geological Society. He subsequently included it, with such improvements and additions as were deemed necessary, in his book on the interior of Ceylon. Of course the science of geology has greatly advanced in the sixty years which have elapsed since Davy wrote, especially in a knowledge of the laws which have produced and are still producing the metamorphic rocks, but although Davy's theories have been improved upon in some respects, and a good many additions made to the facts recorded by him, his observations on the rocks and minerals of Ceylon have formed the groundwork of nearly every attempt made since then to give an idea of our geology and mineralogy.

Our correspondent will feel the truth of this statement, if, after reading the chapters on the subject in Davy's book, he subsequently peruses those in Pridham's work (a boiling down of previous works on Ceylon and so of considerable value) and in the book on Ceylon by an officer of the Ceylon Rifles, a book of which it may almost be said that it "fell stillborn from the press." The Rev. Dr. Macvicar, the first Chaplain of the Scotch Church in Ceylon, made some interesting observations on the geology of Ceylon, but the first and only attempt to give, in a separate paper, a comprehensive account of the geology of our island was made by Dr. George Gardner, Superintendent of the Peradeniya Gardens. The paper forms an appendix to the late Mr. George Lee's translation of the French version of Ribeiro's account of Ceylon, published at Colombo.

Sir J. Emerson Tennent, in writing his great work on Ceylon, besides having access to all previous works had the advantage of personal intercourse with Macvicar, Gardner, and other observers in systematizing the results of his explorations. In addition to all this he availed himself of the results of a partial survey and reports made by Dr. Gygax, a Swiss scientist who happened to be in the island and was employed by Lord Torrington's Government. The result of the whole is a very interesting summary of the geology and mineralogy of Ceylon in what is still *the* great book on Ceylon, although Tennent, over-sanguine about a theory which would have been grand had it been well founded instead of wild and baseless, allowed himself to be misled by Gygax (himself in some inexplicable manner deceived) into asserting the presence, in connection with millions of tons of iron ore, of anthracite in such quantity that it could be laid down in Colombo at 18s per ton! It became the duty of the writer of this article, in preparing for the transactions of the local Asiatic Society the fullest and most complete account of the mineral graphite or plumbago ever yet written, conclusively to show that no trace of anthracite is to be found in Ceylon, while all the probabilities are against coal in any

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shape existing in our formations. Let our correspondent observe the caution thus given, in reading the latest attempt at summing up the main facts in the geoloy of this island, contained in the account of Ceylon given by Mr. J. F. Dickson in the new edition of the *Encyclopædia Britannica*. Scattered in various periodicals, especially in the transactions of the local Asiatic Society, are a number of interesting papers by Dr. Kelaart on upcountry laterite, by the late Mr. Oswald Brodie on salt formations, and, of special value a more complete and more correct list of the minerals of Ceylon than that of Gygax, by Mr. Alexander Dixon. This recent and careful observer saw no trace of coal in any shape, although he noticed slight indications of tin and copper. As yet, however, our only economic mineral of consequence is plumbago, of which in its purest carbon form the island has almost a practical monopoly. Dr. Trimen, in a paper on the botany of Ceylon, glances at some interesting theories connected with its old-world geological history. In this sketch we have not, of course, included all fugitive articles or chance wrtiters on the geology of Ceylon, and we were about to claim that we thought we had omitted no work or writer of importance, when we recollected the "Circular Notes" of that most accomplished but perhaps somewhat imaginative geologist, ths late Mr. Campbell of Islay.

Such generally being the information available, we may add that the accepted theory is that the dynamic forces which originally raised Ceylon "from out the azure main" are still at work and that a slow, very slow process of upheaval is going on. We cannot tell what the rocks are "all the way down," or to the centre of our globe, but our obvious foundation rock is primitive granite. It is not only our lowest but our highest formation, for it has in some places been so projected as to form the rocky domes and pinnacles of nature's temples on our mountain tops. Granite, grey and red, with porphyry and sienite, occasionally occur amongst our most prevalent formation, gniess, which overlies the granite. The igneous rock, according to the received theory, pushed up the stratified rock, gneiss, from the ocean in which it had slowly formed, the gneiss in its turn pushing up beds of crystalline limestone (dolomite), which had formed, also in the ocean, over the surface of the gneiss. These are our three principal and primitive rocks, gneiss being king of all. Indeed, some have held the view that true granite where in contact with its allied rock, has been compelled to enter on the metamorphic processes, which have given gneiss such protean shapes, colours, and conditions. While granite is being metamorphosed into gneiss at one end of the scale, gneiss decaying from the action of the atmosphere on superabundant felspar, is, at the other forming new combinations, and giving us the valuable laterite locally known as cabook (sometimes called iron clay); good as blocks for building purposes, as gravel for road material, and as it is further acted on by the atmosphere and man's agency, the foundation of our most fertile soils. The characteristics of this curious product of gneiss will be thoroughly discussed and settled before the discussion on its failure as a foundation for the Maligakanda reservoir closes. We may just notice in passing that while the red colour produced by peroxide of iron distinguishes some of our very richest soils, oxides of iron in other shapes are charged with the strangely contrasted barrenness which distinguishes our upland patanas (mountain prairies or savannahs) from the rich forests from which they are in most cases so sharply divided. The superabundant iron in Ceylon was formerly utilized by the natives, many furnaces and much slag being scattered over the land, but now the imported metal has put an end to all local manufacture. Felspar, besides leading to the decay of gneiss and its transmutation into laterite, is the origin of the beds of kaolin or China clay, pretty common in our hill system, and also of the very pretty but not intrinsically valuable moonstone, with its semi-pearly lustre. The more kaolin in the rock, the more potash in the soil. When coffee was our great cultivation the quantity of lime contained in our gneiss-derived soils was deemed deficient, either for fertilizing purposes or for keeping the clay soils mechanically free. But for

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tea cultivation the stiffness of our clayey soils and the large proportion of ferruginous constituents in them are not disavantageous. The strong taproot of the tea plant opens up the stiff clay subsoil, while the presence of iron in quantity not deemed beneficial for coftee, seems to suit tea admirably. The mineral constituents of our soils and the proportions of humus and other organic matter vary considerably, but of late years the tendency of opinion is that the fertility of our Ceylon soils, especially those of the mountain region (about one-sixth of the whole), has been considerably underestimated. Tea, at any rate, seems to grow well in all localities, where the rainfall exceeds 70 inches per annum. The disintegrating and denuding effect of the tropical heat and violent monsoon rains on our mountain gneiss formation is very marked, and the slow rise from below believed to be going on is quite necessary to preserve the equilibrium. Curiously enough the presence of garnets in our gneiss, and much of it is excessivily garnetiferous, seems to promote decay as much as excess of felspar does. Large and most beautiful hand specimens of rock sparkling with garnets were obtained from the centre of the great slip which recently took place on the railway. As a gem, the red garnet is not found so as to be of special value, but "cinnamon stones" are amongst the common precious stones of the island. The fine blue sapphires for which Ceylon is so famous, rubies (the same stones only differently coloured) and most of our gems are derived from decomposed gneiss, being crystallized clay generally, but our second primitive rock, the crystalline limestone, is in some cases, as at Matale and in Uva, bright with spinel sapphires. The mountain limestone is generally too largely composed of magnesia to be of good quality for building or agricultural purposes, but in some places it exists as an almost pure carbonate of lime, fit to be usefully polished into marble, and burnt into lime for whitewash and cement or as a soil fertilizer. Our harder forms of gneiss can also be beautifully polished; for instance that quarried at Mahara for the grand Colombo Breakwater. A polished column in the Museum, in which grey, black and green tints are harmoniously combined, is much and deservedly admired. Equally beautiful, when properly polished, are specimens of the red granite or granitic gneiss which is found a few miles distant from this quarry, south of Henaratgoda. Swallow and bat caves exist in the gneiss formations, as well as in the limestone, but nitre forms chiefly in the limestone caves, we believe. The soils of the regions of outlying hills, standing in small ranges and detached masses, beyond, sometimes far distant from the limits of the mountain zone, differ essentially from very poor in some portions of the south-west to very rich in the north and east. Between the vast boulder of Dambulla for instance and the hill of Mihintale near Anuradhapura, the soil is rich to a degree, wanting only irrigation water to restore it to its ancient fertility. Tennent's theory is that Sigiri, Mihintale and other detached hills were "shot up" as they stand, when our mountain system, with the centre of activity near Adam's Peak, was upheaved. Mr. Campbell, in looking from Dambulla rock over the vast eastern and north-central plain, imagined the action of an ancient ocean striking against the cave rock. But during a recent tour in this region we looked in vain for traces of marine remains, and our inclination is to regard Sigiri, Mihintale and the mysterious range of Ritigala as the surviving remnants of a mountain and hill system which once covered the larger portions of the island, the rich soil of Nuwarakálawiya being the result of the decomposition of the softer gneissic rocks. Our theory must be taken at what it may be deemed worth. Other theories, while questioning any closer junction with the Indian continent than now exists, represent Ceylon as having been part of a region which stretched to the Maldives on the one hand and to Sumatra on the other. Tradition on the other hand points to vast subsidences. Populous places which have left no trace are stated to have been submerged off the west coast of Ceylon, while the Basses Rocks, on the south-east coast of the island, are supposed apparently with good reason, to be the remains of a greater Lanka than

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now exists. There is a sudden sinking of the sea bottom to great depths at Trincomalee on the east coast and also in the Gulf of Mannar, supposed to indicate ancient earthquake action and subsidence. There is, appearently, no evidence of *recent* volcanic action in Ceylon, and the hot wells which exist are said by some to be due to the chemical action of subterranean vegetation, rather than to any volcanic products. But here we are on doubtful ground. Basalt seems certainly to exist in Ceylon, but in a very altered condition. We have already noticed the existence of veins of plumbago. It is found generally in association with quartz, and its great purity is due to the fact that in this island, unlike the conditions in India, it is scarcely ever found in association with and contaminated by lime. Gold in the form of dust is widely distributed. It was gathered in the rivers from far back in antiquity, and Australian diggers, a generation ago, created a "rush" to the Mahaoya. More fever than gold was the result, but it seems pretty certain that deep digging into the quartz reefs near the sources of this river in Dolosbage, as well as in other places (notably Ratnapura, where small nuggets have been gathered), would give profitable results to skilful miners backed by capitalists. Meantime the true wealth of Ceylon is in its soil, under the influence of its genial climate.

The vast mass of Ceylon consists of primary rocks or soil and alluvial matter derived from their decay. Our recent formations consist, we believe we may say, exclusively of various forms of what geologists term breccia. This formation, or rather re-formation, of existing material and of foreign material driven on our shores by currents (which specially abound off Ceylon, reaching our island in some cases from far off Australia) is confined almost exclusively to the sea coast. The only marked exception is in the case of the recently elevated northern end of the island, where in a sketch map Tennent represents the "Madrepore" region as extending southwards as far as a straight line from Mannar to Mullaittivu would include, while, going well inland from Mannar, it stretches along the north-west shore until it comes to a point opposite the island of Karaittivu and the principal pearl banks. The total area thus shown compares in size with the mountain system, but we cannot help suspecting it is somewhat exaggerated, for during a recent journey nothing struck us more than the absolute disappearance of any trace of marine formations or products at a short distance inland from Mannar. On the bund of the Giant's Tank, for instance, there are some blocks of coral breccia. But they are as markedly of distant as the gneiss is of local origin, the latter rock being abundant in the river close by. One of the most curious and valuable forms of breccia in the island is that which forms on the sea-shore north of the Kelani river, near Colombo, and which, beautifully stratified, as grey, yellow, or black ferruginous sand predominates, forms cliffs rising to twelve feet high in some cases. This rock, which can be absolutely seen in the process of daily formation, and which yet yields a valuable building material (Pamunagama stone), is, from its highly arenaceous character, naturally enough, known popularly as sandstone. Its constituents include not only the sea shore-sand and matters carried by and deposited from currents, but detritus brought down by the rivers and driven on the shores by the monsoon waves. Fragments may be found in this formation, not only of all the materials—quartz, mica hornblende and felspar,—of our primitive rocks, but also of the precious stones which exist in the alluvium through which the rivers, after escaping from the mountains run. We quoted recently, from Mr. Haly's Museum Report, a notice of some curious breccias found by him on the shores of the bay in which our chief pearl banks are situated. This we now requote :—

"Opposite Karaittivu the coast is particularly interesting, and I explored it as far as Kudramalai point, and collected specimens of the formations, duplicates of which have been sent to Berlin with a short description of the coast. The specimens I procured were, first, a kind of laterite, of which fragments that had fallen in the sea became hardened, and acquired a polish, showing the constituents of the rock very clearly. The most remarkable circumstance about

the fragments is, that they are full of pieces of shell. I had little time at my disposal for thoroughly examining the formation, but as far as I could see, there was no trace of fossil shells to be found in the cliffs themselves. Whether they really do exist in the cliffs, or whether the fragments are first broken up and then mixed with the broken shells, and reunited by the action of the water, I cannot say, and I trust the Berlin geologists will be able to inform us. Secondly, fragments of the upper part of some lofty limestone cliffs, most peculiarly weathered, these cliffs look like coarse sandstone, but the application of acid reveals their true character. Thirdly, fossil shells, all of one species, from the base of these cliffs. These are undoubtedly true fossils. Fourthly, specimens of the limestone, as it crops up through the beach. Fifthly, specimens of raised beach a few feet above the sea-level—a conglomerate of recent shells and corals. Sixthly, specimens of shells from the forest soil resting on this raised beach; it is in some parts ten feet or more in thickness, and is full of shells of the same species as are now living on the surface. Seventhly, specimens of the same soil hardened by the action of the sea, and again worn by exposure to the atmosphere. Pottery and recent fresh water shells are sculptured out in the most delicate manner by the gradual wearing away of the hardened earth. Numerous specimens of recent marine shells are found in the lower part of the forest soil, and also immense quantities of pearl-oyster shells mixed with pottery, showing that a pearl-fishery existed here in very ancient times."

We also quote our own remark on Mr. Haly's statement:—

"As to the curious formations and re-formations found by Mr. Haly on the shores opposite the pearl banks, we venture to predict that the *savants* in Berlin will decide that the rocks were first comminuted by attrition and then glued together, with shells intermixed by the large quantities of carbonate of lime in the sea water, the mineral mentioned being that, without abundance of which present, pearl shells in millions of millions during countless generations could not have been formed."

We may also refer our correspondent to our recent article, in which we traced the mud which so abounds near Puttalam and is filling one lagoon after another on the north-western coast, to currents from Southern India, sweeping round and striking on to our coasts. To currents such as these are attributed the shifting sheets and "dunes" of sand and even the red soil which overlie the so-called madrepore formation of the Jaffna Peninsula. That formation in geological parlance is as much a breccia as is the "sandstone" near Colombo. But the Jaffna breccia, blocks of which also make good building material, are composed almost exclusively of carbonate of lime, while the soil which overlies them is largely siliceous. If the geological theory is correct, only the coral foundation is of local origin, the sand and the arable soil being contributions from the coast of Coromandel, borne across the strait between Point Calimere and Point Pedro by bountiful currents. The origin of the limestone breccia seems obvious enough. The sea-water off the northern coast of Ceylon (and the same is true of the southern coast between Galle and Matara) must be permeated with carbonate of lime, and the coral insects (polyparia) are now, as they have been for countless age, incessantly at work* elaborating this substance into beautiful shapes, from immense masses of brain coral, almost solid, to the most exquisite traceried branch corals, the hues of which in the water are varied and brilliant, including green and gold and loveliest pink shades. From the violence of the waves and by processes of natural decomposition which doubtless accompany certain stages of life in the zoophytes, the corals thus formed have been broken up, comminuted by attrition and finally agglutinated together by the

* When resident at Point Pedro, we were able occasionally to see these curious creatures at work on their stony skeletons or abodes. They were covered with a slime of jelly-like carbonate of lime, which they were depositing on strictly mathematical lines, their up and down motion in the process reminding us of that of a saw, rising out of and sinking into a pit.

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abundant carbonate of lime into breccia, into which dead and broken shells also entered. Gradually the fragments solidified into the form in which the "madrepore" now exists, and the elevating process already alluded to having raised portions of this formation to or a little above the surface of the sea, the theory is that currents carrying sand and soil from the coast of India did the rest. Our correspondent entertains a different opinion regarding the origin of the red soil of Jaffna, and we shall be very glad to publish his views, if he will furnish them for information and discussion. In 1846-47, the late Rev. R. H. Hoisington sent us several analyses of Jaffna soil, amongst the rest that of the hills of white-ants, and if the records of Batticotta Seminary are searched, we think it highly probable that copies of the analyses will be found included. There is a natural formation of salt near the marine stream (haunted by crocodiles) at Tondaimannar, about seven miles west from Point Pedro. We do not recollect seeing evidences of the presence of oxide of iron in connection with this formation, but we know that when we sent Mr. Steele, when he was Assistant Agent at Hambantota, a notice of the great Sambur Salt Lake in Rajputana, showing that deep red contrasted with the silvery white crystals of the salt, Mr. Steele stated that the effect of peroxide of iron was also visible in the salt "lewayas" of Hambantota; which by the way are in the neighbourhood of drifting sand "dunes" as formidable as those on the north-east coast of Ceylon. Our correspondent will, of course, direct his attention to the limestone caves at Alvai, a little inland from Point Pedro, in which it is supposed is the source of the fresh water which bubbles up in the sea near Kankesanturai. He will also study Tennent's extraordinary theory (founded on a popular belief), that besides fresh water seeking the sea (as is natural) in the Jaffna "madrepore" formation, the sea water goes inland, *against* natural laws, the substratum of salt water at the bottom of the Puttur well forcing up the fresh! A paper dealing fully with the peculiar physical conditions of the Jaffna coral formations, overlaid by Indian sand (and soil ?), could not fail to be very interesting.

Dr. John Davy was himself never able to visit Jaffna, but he analyzed specimens of rock and soil received from his friend Mr. Finlayson, and this is what he wrote:—

"This limestone contains numerous shells: it is generally grey or light-brown, very fine-grained and compact, and breaks with a conchoidal fracture. The specimens I have tried, have been very nearly pure carbonate of lime, exhibiting slight traces of the presence of vegetable or animal matter, and containing a little water. It is not confined to the island of Jaffnapatam: it occurs in the district on the mainland, and has been observed by Mr. Finlayson as far as Palwerayenkatte, where he found it with coral rock, in a salt-water lake, at a little distance from the sea, with which the lake communicates in the rainy season. Where it occurs, the whole of the country is similar; level, without hills or even hillocks and elevated a very few feet only above the surface of the sea, by which, at no very remote period, there is good reason to suppose, it was once covered. The retiring of the sea from this district does not admit of a doubt. It is evident within the memory of man; many individuals recollect the waves breaking where their spray now seldom reaches. Now is it less evident, perhaps from the nature of the land as dercribed, and from the circumstance of coral rock being found mixed with the limestone rock several miles from the sea. It is always more easy to observe the phenomena of nature, than to point out their causes, especially in geological changes, such as the present, which are not watched in the act, and are noticed only when completely accomplished. Minute enquiry, on the spot, it is very likely, might afford a clue to an explanation of the formation of this rock, which, in all probability, is still going on in the shallows was of the adjoining seas, and along the shores of Jaffnapatam. Its formation, it may be conjectured, may be connected with coral which abounds greatly in the narrow sea, between Ceylon and the continent of India, to such an extent, indeed, that most, if not all the islets in that sea,

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are composed of it. The difficulty is to find the cause of the solution of calcareous matter in some places, and its precipitation in others adjoining. Perhaps, in the deeper, cooler water it is dissolved, and in the warmer, shallow water it is precipitated. The solution is aided, perhaps, by the presence of a little carbonic acid, and the precipitation is assisted or produced by the escape of the acid gas. This is mere conjecture, but of that kind that it admits of being tried by the test of experiment."

Again, writing of Ceylon soils, he remarked:—

"The most striking instance to be adduced, of soil destitute of calcareous matter, and incumbent on a bed of coral, is the common soil of the coral island Delft, off the coast of Jaffnapatam, celebrated for its excellent pasturage. It is a dirty-yellow, very fine sand, slightly cohering which consists, in its dried state, of

95.0	silicious sand coloured by iron, with perhaps a very little alumine
2.5	vegetable matter
2.5	water
100.0	

"Nor hardly less remarkable are some of the soils of Jaffnapatam, for which as well as those of Delft, I am indebted to my friend, Mr. Finlayson. Two instances may be mentined,—one of a soil of a tobacco field, which is manured by means of sheep, like turnip-ground in England; the other of rice-ground, which receives no manure, but is carefully irrigated. The tobacco soil, of a reddish-brown colour, collected when perhaps partially exhausted, the crop not having been long taken off the ground, consisted of

95.5	silicious sand, coloured by iron with a few particles of calcareous matter
2.0	vegetable matter
2.5	water
100.0	

"The rice soil, of a light grey colour, containing a good deal of straw in a finely divided state, consisted of

95.5	silicious sand, with traces of iron, carbonate of lime and alumine
2.5	vegetable matter
2.0	water
100.0	

"It seems extraordinary that in islands, the foundations of which are calcareous, there should be so little calcareous matter, and so large a proportion of silicious matter, in the soil. It is a subject deserving of minute inquiry on the spot; perhaps, the fine silicious sand is drifted there by strong winds from a distance*; and perhaps as already hinted, the calcareous matter is washed out in process of long time by the action of the heavy periodical rains."

It will be seen that Davy referred the origin of the siliceous soil superimposed on the limestone base, to wind instead of water currents. As there is an interval of only 40 miles between Point Calimere on the Coromandel Coast and Point Pedro in Ceylon, and as the wind currents in the north-east monsoon are exceedingly powerful, aerial currents may certainly have done their part in supplying Jaffna with soil.—Dr. George Gardner was able to personally visit Jaffna; he wrote in 1847, about a third of a century after Davy had recorded

* There are very many instances of sand being carried to a great distance by the wind. On our voyage from India, approaching Table Bay, at the Cape of Good Hope, the S. E. wind blowing strongly off land, was so impregnated with a subtle sand, like that of Delft, that it proved very troublesome, even three and four miles off the shore.

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the facts and opinions we have quoted, and this what he said of the geology of the Peninsula:—

"Passing over all those series of rocks to which the names of secondary and tertiary have been given, none of which are known to exist in Ceylon, we come to those very modern ones called post-tertiary, which are being formed at the present day, and which either shew themselves in the shape of elevated terraces of shells, or in a more solid form arising from the agglutination of particles of sand and fragments of such coralines and shells as still inhabit the surrounding seas. Such elevated shell banks, and such rocks are to be met with in several places along the coast. Thus the greater part of the Peninsula of Jaffna is formed of them, and I have likewise noticed their existence at Galle and at Belligam. The study of these modern formations is of peculiar interest to the Geologist, as they are fraught with important analogies as to the process of nature in more ancient times. At Jaffna the lower portions of this breccial rock is quarried for building purposes. It is compact in its structure, but abounds in very perfect remains of shells and corals, and in its general structure resembles very much the same kind of rock in which human remains have been found on the north-east coast of the main land of Guadaloupe. Along the shores of the lagoon which separates the main land from the peninsula of Jaffna, and but little elevated above the present sea level, the formation of this rock may be seen in various states of progress towards solidification. Some specimens which I collected there consist of nearly an entire mass of small shells similar to those which are still found abundantly alive within the present tidal range, and are beautiful examples of the manner in which those lime-stone rocks of the secondary strata which are so full of the remains of shells and other marine animals, have been formed."

Finally we quote from the work of Sir Emerson Tennent:—

"The land has for ages been slowly rising from the sea, and terraces abounding in marine shells imbedded in agglutinated sand occur in situations far above high-water mark. Immediately inland from Point-de-Galle, the surface soil rests on a stratum of decomposing coral; and sea shells are found at a considerable distance from the shore. Further north at Madampe, between Chilaw and Negombo, the shells or pearl oysters and other bivalves are turned up by the plough more than ten miles from the sea.

"These recent formations present themselves in a still more striking form in the north of the island, the greater portion of which may be regarded as the conjoint production of the coral polypi, and the currents, which for the greater portion of the year set impetuously towards the south. Coming laden with alluvial matter collected along the coast of Coromandel, and meeting with obstacles south of Point Calimere, they have deposited their burthens on the coral reefs round Point Pedro; and these gradually raised above the sea-level, and covered deeply by sand drifts, have formed the peninsula of Jaffna and the plains that trend westward till they unite with the narrow causeway of Adam's Bridge—itself raised by the same agencies, and annually added to by the influences of the tides and monsoons.*

"On the north-west side of the island, where the currents are checked by the obstruction of Adam's Bridge, and still water prevails in the Gulf of Mannar, these deposits have profusely heaped, and the low sandy plains have been proportionally extended; whilst on the south and east, where the current sweeps unimpeded along the coast, the line of the shore is bold and occasionally rocky.

* The barrier known as Adam's Bridge, which obstructs the navigation of the channel between Ceylon and Ramnad, consists of several parallel ledges of conglomerate and sandstone, hard at the surface, and growing coarse and soft as it descends, till it rests on a bank of sand, apparently accumulated by the influence of the currents at the change of the monsoons. See an *Essay* by Captain Steuart *on the Paumben Passage*, Colombo, 1837. See Vol. II. p. 554.

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"NORTHERN PROVINCE.—*Coral Formation.*—But the principal scene of the most recent formations is the extreme north of the island, with the adjoining peninsula of Jaffna. Here the coral rocks abound far above high-water mark, and extend across the island where the land has been gradually upraised from the eastern to the western shore. The fortifications of Jaffna were built by the Dutch, from blocks of breccia quarried far from the sea, and still exhibit, in their worn surface, the outline of the shells and corallines of which they mainly consist. The roads, in the absence of more solid substances, are metalled with the same material; as the only other rock which occurs is a description of loose conglomerate, similar to that at Adam's Bridge and Mannar.

"The phenomenon of the gradual upheaval of these strata is sufficiently attested by the position in which they appear, and their altitude above high-water mark; but, in close contiguity with them, an equally striking evidence presents itself in the fact that, at various points of the western coast, between the island of Manaar and Karativoe, the natives, in addition to fishing for chank shells* in the sea, dig them up in large quantities from beneath the soil on the adjacent shores, in which they are deeply imbedded.†

"The sand, which covers a vast extent of the peninsula of Jaffna, and in which the coconut and palmyra-palm grow freely, has been carried by the currents from the coast of India, and either flung upon the northern beach in the winter months, or driven into the lake during the south-west monsoon, and thence washed on shore by the ripple, and distributed by the wind.

"The arable soil of Jaffna is generally of a deep red colour, from admixture of iron, and, being largely composed of lime from the comminuted coral, it is susceptible of the highest cultivation, and produces crops of great luxuriance. This tillage is carried on exclusively by irrigation from innumerable wells, into which the water rises fresh through the madrepore and sand; there being no streams in the districts, unless those percolations can be so called which make their way under-ground, and rise through the sands on the margin of the sea at low water."

Tennent talks of the subterranean water rising fresh through the coral, but we submit that much of the good effect of the numerous irrigation wells by means of which the Jaffna Peninsula is cultivated like a garden, is due to the fertilizing salts of lime brought up in the ola baskets with the irrigation water.—We trust the information we have thus brought together may be useful to our correspondent and others, but a regular scientific survey of and report on our rocks and minerals is a desideratum still to be supplied. For instance, the received opinion is founded on the fact that there are no lakes amongst the mountains of Ceylon that none ever existed. We hold strongly, contra, that the Plain of Nuwara Eliya is the bed of an ancient lake whence, when the barriers were worn away or broken up, the waters escaped into Uva on the eastern side; into Dimbula on the western. There are other similar localities amidst our mountains, and the valley of Maturata is so narrow and its sides so steep that it resembles the formations called canyons, down which rivers tumble over sheer precipices into the Yosemite valley in California. We cannot help thinking that captured water, long retained but finally breaking the barriers which confined it, has had something to do with this formation and similar ones in our Ceylon mountain system.

While we are writing a specimen of rock is brought to us taken at a depth of 70 feet, from the borings which are going on at Mannar, with the hope of finding a perennial supply of water at that truly penal station, where, what

* *Turbinella rapa*, formerly known as *Voluta gravis*, used by the people of India to be sawn into bangles and anklets.

† In 1845 an antique iron anchor was found under the soil at the north-western point of Jaffna, of such size and weights as to show that it must have belonged to a ship of much greater tonnage than any which the depth of water would permit to navigate the channel at the present day.

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with glare and heat, the paucity of rain and the absence of good water, life must be very difficult to live. The hard rock to which the borings have reached, after passing through much soft breccia, is of course the underlying gneiss, which crops up at Puliyadiyirakkam on the Ceylon mainland and in the island of Ramesvaram and which is conspicuous in the beds of the Aruvi Aru and other rivers which enter the sea near Mannar. At present the supply of fresh water for the residents of Mannar is obtained from a couple of wells dug in the sand, about two miles distant, the rain water caught in the old Fort reservoir being of very small account. A plentiful supply of good water would make all the difference in the world, and we trust Government will not grudge a substantial vote, say R1,000, instead of first R250, and then R120, which have been allowed. Many a convict in our jails has better prospects of life and health than persons condemned to live at Mannar, and as we are so careful about the health and life of our prisoners, we ought to extend at least equal privileges to honest people condemned to live at a place on which nature has largely laid her ban in the shape of drought and fever.

THE GOLD REEFS OF MYSORE.

We have received from the Mysore Government a copy of Mr. Foot's report on the gold-bearing region of Mysore. The following notice in the *Pioneer* fairly indicates the leading characteristics of the report:—

Mr. R. B. Foote, Superintendent of the Geological Survey, has completed his survey of the auriferous tracts in Mysore, and the report he has submitted to the Dewan will be read with great interest. The mines of Mysore have not hitherto turned out the El Dorado which was expected six or eight years ago, and capitalists are beginning to have an uneasy feeling that their money might have been better invested where, though the promise was less alluring, the fulfilment was more safe. To such as these Mr. Foote's report will be to a certain extent re-assuring. He says nothing of monster nuggets or "lumps of gold," of which doubtless many imaginative shareholders have dreamt, and he notes several instances where surveyors who went before him have given exaggerated or utterly unfounded accounts of the mineral wealth of certain districts; but, on the other hand, he found many workings where the reefs were fine and of very great promise. Generally his report may be said to bring out two things; first, that prospecting must in most cases be carried to a considerable depth before the value of the mines can be accurately gauged; and secondly, that the whole of the auriferous areas are deserving of close survey, as even the best of them are imperfectly known, and of what was known to the old miners in former generations much has been forgotten. In Mr. Foote's tour, which was for some reason or other very hurried, he chanced on no less than five sets of old workings unknown to previous surveyors, and he suspects that many others exist in the wild and jungly tracts which abound in the hilly and mountainous parts of the country. Although the work of gold-prospecting left Mr. Foote little leisure to devote to any non-metallic minerals, he took some interesting notes on such as incidentally came in his way. One very beautiful variety of granite-gneiss eminently fitted for cutting and polishing on a large scale, he found about two miles east of Banavar. The rock he declares to be the handsomest he has seen in Mysore, and monoliths of large size could easily be quarried. Again, the hills above Seringapatam are traversed by a great dyke porphyry of a warm brown colour. The stone in Mr. Foote's opinion is unequalled in Southern India, and, if highly polished, would rival the highly-prized porphyries of olden days. The dyke is fully a mile in length and of great thickness. Beds of marble of good quality were also found near Holgere. Mr. Foote, however, met with nothing to support the opinion to which

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previous surveyors—Mr. Lavelle in particular—had given currency, that emery, asbestos and kaolin existed of a quality and in quantities such as would warrant the investment of capital for their exploitation.

THE OPAL KING AND HIS COUNTRY.

Queensland Opals, and how they are Found.—The other day we printed a ten-line paragraph taken from an American paper concerning some sham opals which were being extensively manufactured in Mexico. Now, these few lines chanced to fall into the hands of his Majesty the Opal King, who is at present in London. He wished it to be known that his opals could not be imitated. This gentleman—a king can be no more—it was who discovered the existence of the brilliant jewel in Queensland, and after seven long years of working in the opal country he left the torrid skies of Queensland for the old country. The history of that discovery his Majesty related to me, together with many graphic stories of his adventures, and of these I propose to give a brief epitome. I may mention that the King is also known as Mr. H. W. Bond; his palace is at Torrington, Toowoomba; and his visit to England was undertaken partly for financial reasons. He found his territory too extensive to work alone; so he has put the opal country in the market, and floated an Opal Company, with £100,000 capital, just as Mr. Allan Quatermain would have floated King Solomon's treasure. He himself goes back in a week or two to superintend the working of the mines.

Fifteen Thousand Pounds' Worth of Opals.—I called upon Mr. Bond at the Bank of Queensland, in Lombard-street, and with Sir Seton Gordon and another gentleman, was taken upstairs to see the opals. After some little delay, a small cardboard cabinet, about eight inches high and as many wide, was brought into the room, by two officials, who broke the seal and untied the red tape with which it was bound. Mr. Bond then pulled out each of the three drawers, in which were little black paper packages—opals wrapped up like seidlitz powders! Each of these was opened, and the table was soon covered with a brilliant collection of beautiful stones, each flashing with a thousand prismatic lights. Another and larger parcel was also opened, containing, perhaps, five or six hundred smaller stones; and, as Mr. Bond, carefully turning them over in his hand to show their brilliant hues, told me, the contents of the box were worth about £15,000 in the market. They were then carefully put to bed again, sealed up, and taken away to the safes below by their two grim guardians.

The Green Lustre of the Queensland Opal.—I am told that hitherto the opal market has been chiefly supplied from the mines of Hungary, which produce the well-known milk-hued gem. The stones which come from South America are milky but less fiery than their Hungarian rivals. The Queensland opals may beat these out of the market, because of their greater brilliancy and the presence of a vivid green lustre in the gems from one of the three mines now conducting operations in Queensland. Mr. Bond informed me that the opal was vomited out by geysers in remote epochs, and produced from the cavernous depths of a well-worn black bag a number of specimens of the raw materials. Without going into geological details, it may be said that the opal is found enclosed in little round stones, like a kernel in a nut, and also in another formation, which runs in layers. The nut is cracked with a tomahawk, and there is the opal stone.

The Opals in the Old Beef Bag.—Mr. Bond has the tanned face of a man who has been exposed for many years to the burning sun of the tropics, and as for his prospecting adventures, I dare say he could fill a book with them. He first came on the track of opals about seven years ago, when working far away from his own station, 800 miles west of Toowoomba. He was driving cattle to some station near Cooper's Creek, when one night he fell in with a

stockman who was looking after a remote part of the run. This man took him aside, and told him how he thought he could show him something worth the seeing, and which he was also anxious to have his opinion about. Going to the back of his hut, he removed a mass of rubbish, and produced a dirty beef bag. Opening the mouth and diving down, he brought up about thirty pounds' weight of opal matrix. He had been riding after his cattle one day when his eye was caught by something in the grass which flashed in the sun. Long exposure to heat and rain had caused some of the nodules to split, and exposed the lustrous stone encased within. Mr. Bond gave the man a cheque for two or three hundred pounds for the stone and his information, and took up the land indicated.

Seven Years with Blanket and Billy.—The news soon spread. He was pegged out all round—that is, other enterprising gentlemen came up with their picks, shovels, and blankets, and followed his example. But luck favoured Mr. Bond: their patches were valueless. The value of a gem depends to a large extent on its rarity, and it would have depreciated the value of the find if similar discoveries had been made. For seven years Mr. Bond has been prospecting this patch of country with the utmost care, at a cost of nearly £15,000. Generally alone, he has ridden over the rolling lands for months together, with all the ardour of the born prospector, steering his own course through these trackless wilds, heedless of blacks, boiling his own billy, shooting his own tucker. I have no space to tell how, with great difficulty, he got a surveyor to ride those 900 weary miles to peg off his claims, how the surveyor, when half way, wanted a nip of whisky, how Mr. Bond took him 170 miles out of his way to get it, how they missed it after all, and only found one bottle of sweet champagne and another of orange bitters at the bush shanty, and how he has drunk Worcester sauce instead of whisky for months. "They say we are exterminating the blacks with fire-water," said Mr. Bond with a laugh; "by Jove! it's too much trouble to get it for ourselves, I can assure you, and after paying twenty-five shillings a bottle for it the nigger does not get much."

The Country where the Opal is Found.—But what is this opal country like? We give a little sketch of it, and also a short description from the pen of Mr. Robertson, the geologist who explored the country. "We had for days," he says, "been riding through a broad belt of rough and disconsolate scrub, breathing an atmosphere of pulverulent dust, but after crossing the Grey range, we enter a broad expanse of green and grassy downs. Breathing the ethereal and invigorating brilliance of the dry air, our spirits rise, and we strive to forget the rough usage, the forbidding desolation, and the dust of the past week borne, as we suppose, with exemplary fortitude and Christian forbearance. The silence is profound. Behind us the higher eminences of the Grey range rise as out of a cloud of gleaming vapour, and these, from their appearance are known as the Hay Ricks. Around us, detached squadrons of emus run in uncertain lines, and before us, over a sea of verdure, is the mirage of a great lake. We cross stony ridges, or belts of vitreous and highly transmuted siliceous rocks, over which our unshod horses walk warily, and once again we cross the grassy plain, bearing almost due west. Water is scarce; sometimes spaces of twenty-five miles separate the water holes; in some of these a liquid is seen, resembling in colour and consistency thin white paint, and this decoction is imposed upon strangers as water. It tastes strongly of 'cow.' . . . . Around us the heat quivers in the air, and against their mural sides the bright sun dances with a fierce delight. By dangerous paths we continue to ride up the slopes of these fantastic-shaped hills, and, by some unaccountable accident, arrive in safety at the top."

Alone in the Cenre of a Vast Continent.—"Not a sound (save the panting of our horses) disturbs the solemn and all-prevailing silence. We are alone with nature in the centre of a great continent, and we feel that he in-

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deed must possess a dull and incurious mind who is not impressed by the singularity and the charming loveliness of the scene. Twenty miles off, across a grassy and park-like plain, the Coleman and M'Gregor ranges rise, clear and distinct, amid the flood of light. The outline is wonderfully lovely. In the foreground a number of cone-like and castellated hills of all colours rise from the plain; the more connected ranges of the background appearing as if capped by numerous and enormous fortifications. Some of the isolated conical hills terminate in sharp apexes or spike; others terminate with flat circular crests and perpendicular red sides, rising out of slopes of yellow or reddish earth, partially covered by struggling vegetation. The whole of the hills have approximately the same level or elevation, their contour being entirely due to the effects of climate operating over incalculable periods of time. I regret that I cannot convey to you any idea of their aspect as I saw them, through the clear, ambient air, rising out of the carpet green with the sun to illuminate them and distance to soften and to heighten the effect."

Opals and Fashion.—Mr. Bond has three mines, which his men have been working for the last four or five years, and which he visits three times a year, driving a buckboard buggy and three horses, taking down the matrix to Toowoomba, where it is classed and shipped to Europe. All who visited the Colonial and Indian Exhibition last year must have been struck with the fine display of the cut opals and those in the matrix exhibited by Mr. Bond. The Queen took especial notice of the exhibit, and greatly admired the hitherto unknown hues of these lovely gems. Opals were once considered unlucky by many; but this stupid prejudice is fast dying out, like other old superstitions, such as touching for King's evil. Mr. Bond informs us that the offices of the Opal Mines of Queensland, which company was lately floated, will be opened in a fortnight at 2, Waterloo-place, whence we may expect shortly to have issued opals to meet the fast increasing demand, for, as matter of fact these precious stones, since the Princess of Wales wore them at a recent Drawing-room, have become quite the fashion.—*P. M. Budget.*

THE TRICKS OF THE DIAMOND TRADE.

An Interview with a Mineralogist.

We recently quoted a short extract from an American paper calling attention to the manufacture of false opals in Mexico. This, coupled with an exposé during the present year before a police magistrate of the manipulation to which certain diamonds had been submitted, led our representative to make inquiries into the tricks of the lapidary's trade generally. He accordingly called upon Mr. S. Henson, the consulting mineralogist in the Strand, and the following suggestive report of the interview is the result. Mr. Henson was asked for an explanation of the method adopted by the manipulators of the diamonds which had got into the police court:—

"Ah! that was a very poor attempt," replied Mr. Henson, "and was an American 'notion.' The diamonds detected in Paris as well as those exposed over here all came from America. As to the process, I can only say that it is supposed to consist of some application to the surface of the stone under heat. The nature of the application is not known, but now that this exposure has occurred, it will be difficult to turn the fraud to profit, as one has only to breathe on or moisten the stone, and then by rubbing it the application is easily removed and the true character of the stone becomes exposed at once."

"But apart from this surface manipulation by which the 'off-colour' effect is temporarily removed, what other 'tricks of the trade' are employed in the case of diamonds?"

"Not a few. More, indeed, than one can call to mind at a moment's notice; but to start with, take the 'doublets' as they are called. These are topazes having a thin slice of diamond laid on the visible surface; the topaz

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giving depth and the diamond adding its lustre, the composite stone being sold as a diamond. Then there are the zircons, these stones are composed of 33 per cent of silica and 67 per cent of zirconia, and their value is comparatively trifling. Their lustre is adamantine, but their colours would betray them at once, even to the most careless observer. A means is known, which, moreover, is extensively employed, by which the colours are extracted from these stones, leaving them to all appearance diamonds, till submitted to tests, when, of course, they are at once detected." *

"Are rubies ever manipulated?" "Not so far as I know—that is to say, not in the way you mean, but a red spinel is more often sold as a ruby than the real stone—that is the corrundum ruby—which latter is harder and much more valuable. In the same way French compositions—in which the usual flaws found in nearly all emeralds are carefully imitated—are substituted for and sold as emeralds. It would take an expert to detect these when mounted in an article of jewellery."

"Dyed! what, are precious stones then dyed, in these days of shoddy, china clay, veneer, and Imperial Institutes?"

"Certainly. They are dyed, and in many cases dyed right through, so that you might break your specimen and discover the various colours, say in agates, passing right through the specimen—much to your unsophisticated satisfaction. There is an industrial village called Oberstein, on the Nahe, and not far from the Rhine, which I have visited, and concerning which I can therefore speak from personal experience. That village is occasionally visited by English people, who, after inspecting its shops, fancy—as tourists delight to do—that they have discovered an unknown source of precious things. Exquisite jewellery, superb lapis lazuli necklaces, every bead of which is a treasure, gorgeous agates, marvellous crocidolite of undreamed-of tints, of late even a blood-red tint has been obtained! Alas! for the tourist's future self-confidence, when on his return home he finds his jewellery all brass, his lapides all dyed. That village's industry is devoted to the making of what is known as Brummagem jewellery, and the dyeing of chalcedony &c., for export. Its products are sold everywhere."

"Pleasant, very! Can you explain the process, as it seems extraordinary that anything so hard as agate should be capable of being dyed right through?"

"Agate is only one form of chalcedony out of many. The onyx, carnelian, bloodstone, are other forms familiar to most people. I saw the processes, but the workers were too wary to explain their secrets. Different families have different processes for producing similar results, and in some cases one family's process will fail with a given piece of stone when another's will succeed. It is impossible for the most experienced experts to say beforehand without a trial what colours the various bands of the chalcedony will take. Before purchasing 'lots' of stone for manipulation at the auctions whence the supply of raw material is obtained, every bit or piece of each 'lot' has to be tested by trial, small chips being used for this purpose. As regards the processes, all I can say is that in the case of agates and onyxes, these being 'banded chalcedon'—that is, chalcedony with bands of various degrees of density—the specimens are placed in pots containing the colouring matter and are then subjected to great heat for periods varying from a few hours up to a fortnight or more. Certain bands take the colour, others do not. The stone is, after the first, given a second, and perhaps several more, stewings in pots containing different colouring mixtures. In time every band has received the colour partial to it, so to speak. The results are the beautiful onyxes and agates you see everywhere. The carnelian not being banded, and being of a different density, is treated differently, to enrich the natural colour, heat being the most potent factor. Fluorspar is capable of great improvement in its appearance by being

* Matura diamonds" are zircons, from which colour has been expelled by fire heat.—COMPILERS.

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subjected to heat, and the crocidolite which has lately come so much to the front, owing to recent large discoveries, but the price of an ounce of which, not long ago, would buy a ton to-day, is also dyed past recognition, a means of giving it, as I have said, a blood-red tint having been hit upon. One family has the sole secret of converting crocidolite into 'cat's-eye.' The cat's-eye and emerald are the two most easily imitated stones. Aragonite, crocidolite, and even fibrous gypsum, and some of the hornblendes, are a few of the substances from which imitation 'cat's-eyes' are made. I have not mentioned all the stones treated at Oberstein, but those I have given you are the first that occur to me."—*Pall Mall Budget.*

SEARCH FOR GEMS AND PRECIOUS STONES.

By P. L. Simmonds, F.L.S.

The insatiate desire for ornaments and articles to decorate the person, and hence the race for the acquisition of wealth, gives employment to thousands of persons in different parts of the world, who are kept busily engaged in searching for gems and precious stones, and in this aspect we would consider it here. It is somewhat difficult to know where the line of demarcation as to "gems and precious stones" is to be drawn, and what properly come within this category, for tastes differ materially, and fashions change from time to time. About one or two, however, there can be no doubt as to classification; diamonds and pearls have always been highly esteemed and appreciated, and the demand for these is universal. But there are some stones and substances that have value chiefly in special localities, such, for instance, as jade among the Chinese and Pacific Islanders, from its hardness and rarity; amber among the Chinese, Turks, and Russians; and coral among the East Indians, Chinese, and Africans. The African race appreciate the artificial Venetian beads above any valuable gem, because they have long been familiar to them, and are the fashion.

Precious stones have been prized in all ages for their portability, and high intrinsic value in a small compass. In Christopher Marlow's celebrated play, "The Rich Jew of Malta," the merchant is represented as having before him:—

"Bags of fiery opals, sapphires, amethysts;
Jacinths, hard topaz, grass-green emeralds,
Beauteous rubies, sparkling diamonds,
And seld seen costly stones of so great price,
As one of them, indifferently rated,
And of a carat of this quality,
May serve, in peril of calamity,
To ransom great kings from captivity.
This is the ware wherein consists my wealth!"

A glance over the various regions of the globe will show us men of all races, in large companies, delving in the ground or diving in the sea for this commercial wealth. Indeed, scarcely a sea or a river but has its fleet of boats at certain seasons laden with men eagerly searching for pearls, although it is chiefly in the tropics that these boats congregate. It may prove interesting to gather a few facts connected with this important quest, taking the searchers on land first, and then investigating the rich produce gathered from the sea.

In the Indian Empire there is a great commerce carried on in gems and precious stones, although no reliable data are available, as they are so portable, and there is no absolute necessity for records being kept. The Indian trade returns of the last three years give the value of the imports at an average of £200,000. A large trade is carried on in them to Sewistan, Kashmir, Ladakh, Thibet, Nepaul, Sikkim, Upper Burma, Siam, and Karennee. There is no doubt that through private sources four or five times the reputed values are brought in and also exported each year to Europe.

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There are in India three extensive tracts, widely separated from one another, in which the diamond has been sought for. The name of Golconda, originally applied to a capital town (now a deserted fort in the neighbourhood of Hyderabad), seems to have been used for a whole kingdom; but the town itself is many miles distant from the nearest diamond mines, and it was only the mart where the precious stones were bought and sold. The second great tract occupies an immense area between the Mahanuda and the Godavery rivers; and the third great tract is situated in Bundelcund, near the capital of which—Punnah—some of the mines are found. For those content with a slowly-paying occupation, and a hard life involving close supervision of the workers, diamond mining will pay, provided such persons possess capital sufficient to last them a few years. The diamonds now are usually brought from Parteal, close to the southern portion of the Nizam's dominions. The deepest pits are not more than twelve feet. The matrix of the diamond in those localities is a conglomerate sandstone. The appliances of modern machinery for excavation, &c. directed by men of science, may possibly bring to light gems that have not been discovered by the rude native processes of search.

It would be curious to ascertain the yield of diamonds in the East from those mines in the last 350 years, and of Brazil in the last 150 years since the discovery there, but no such data are obtainable, nor indeed can any reliable estimate be formed of the value of the diamonds owned in different countries. In the United States, diamonds to the value of £1,700,000 were imported in 1886. Two-million-and-a-half carats of diamonds are cut yearly in Amsterdam. Precious stones being free of duty in the chief European countries, no records are obtainable. The Brazilian mines are said to yield about £800,000 of diamonds, and India, Borneo, and Australia £200,000, but these sums are insignificant now in comparison with the South African yield of about £4,000,000 yearly.

The only Indian mines now worked for diamonds are the northern ones in Bundelcund; the produce, between £40,000 to £60,000, is sold locally, and only about 100 carats are sent to Europe. Diamonds have been found in Sumatra and Celebes, but Borneo alone now produces a regular supply, sending it is computed, about 3,000 carats annually into the European market. The discovery of Cape diamonds has reduced the Brazilian mining to a minimum of about 24,000 carats. And here it may be desirable to explain what this fanciful diamond weight is. The diamond grain is equal to about four-fifths of a troy grain, hence four diamond grains are equal to one carat, or 3·174 troy grains. But as half the rough stone has to be cut away in polishing, to estimate the value of a rough diamond, we must ascertain its weight in carats, double that weight, and multiply the square of this product by £2, which may be taken as the average price of rough diamonds that are worth cutting. Formerly, indeed, the price of diamonds was as to the square of their weight, but this rule no longer holds good, as their value mainly depends upon quality.

From the four principal mines in Griqualand (which all lie within a circle with a diameter of three miles), calculating the amount of diamondiferous ground removed, and the known average yield per load in each, it is found that not less than 33,000,000 carats of diamonds (or more than 6¼ tons weight) must have been extracted since the first discovery; realising, in round numbers, £40,000,000 sterling.

The yield of diamonds from the Kimberley mine alone, from the opening in 1871 to the end of 1885, is stated to have exceeded 17,500,000 carats, equal to 3½ tons weight of precious stones, in value about £20,000,000.

To obtain this, as many thousand tons of reef and ground have had to be excavated. The mine is 450 feet deep, and the cubical contents of this huge cavity measures about 9,000,000 cubic yards. Four thousand Kafirs are employed at this mine, and more than 20,000 natives of Africa arrive yearly at the mines in search of work, so that the employment of native labour, and the development of native trade, are incidental benefits conferred on South Africa by the discovery of the diamond fields.

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The Dutch Government are the owners of the diamond mines in Borneo, which are situated in the district of Landak, in the territory of Ponteyanak; they are worked by Dyaks and Malays, but with far superior skill by the Chinese. The gems are found in a yellow-coloured gravel, at depths ranging to 60 feet. Advances are made to the miners, who are bound to deliver all stones at 20 per cent below their market value.

Diamond mining in New South Wales is likely to become of much importance, and the colonists are sanguine of being able to compete with South Africa in this trade. Twelve thousand diamonds have been obtained up to the present time, chiefly from the tertiary gravels and recent drifts in the Bingera, Inverell, and Chittagong districts. The largest diamond yet found weighed 16·2 grains, or about 5⅝ carats. They are of good colour and quality. Companies with large capital are forming to buy up and work the extensive diamond fields in Bingera. Other gem stones found in that colony are garnets, the common emerald (green beryl), oriental emerald (green sapphire), royal blue sapphire, white and pale blue topaz, and agates.

The ruby mines of Burma, when scientifically worked, are destined to yield a vastly increased quantity of this precious stone. There has been lately a sharp competition for the lease of these mines from the British Government, and it is believed that Messrs. Streeter have secured the right for £40,000. It is creditable to England that we have such enterprising firms of jewellers, seeking the produce at the very sources of production, as is evidenced by their explorations in South Africa, their employment of fleets of boats and divers for pearl fishing round the Australian shores, and competition against Indian and Continental firms for the Burma ruby mines. Rubies are of various reds, and the red sapphire or oriental ruby is next in value to the diamond.

It has been well observed that digging for gems, like all gambling speculations, is but too attractive, and great numbers of the rural population in Ceylon and elsewhere neglect the safer pursuits of agriculture for the speculative profits of the gem pits.

Ceylon has always had a reputation for its richness in precious stones. Inferior kinds, such as the moonstone and the garnet, are found in the beds of streams about Kandy, Nuwara Eliya, Badulla, and some of the small rivers of the south, but the more precious stones, such as the ruby, the blue sapphire, the oriental topaz of various yellows, the Alexandrite and the cat's-eye, must be sought within a radius of thirty or forty miles from Ratnapura, the city of gems.

The Ceylon ruby is more frequently of a rich rose colour, having considerably more light and life than its Pegu rival and is preferred by many Orientals to the pigeon-blood ruby, which, although the more costly stone, is invariably less brilliant than the Ceylon one.

The search for gem stones is carried on in the most primitive manner in Ceylon. The soil supposed to be rich in precious stones is rented for an annual sum from the Government. Coolies are set to work to dig the earth, which is heaped up on one side and then washed through a trough with variously sized perforated zinc stops, which retain all stones, according to their sizes. These are placed on a table or flat surface, and the gems are easily distinguished and picked out. The proportion of gems capable of being cut and really marketable is not more than 1 per cent.

Of the silicious gems, the amethyst of a purplish violet hue is the most valuable. The best amethysts are brought from Cambay in India, and from Siberia, Ceylon, and Persia, where they are found both lining the cavities of geodes and in rolled masses. The chief supply of the blue turquoise is drawn from the peninsula of Sinai, the great mining district of the ancient Egyptians.

Among the Moors, rubies and emerals, generally uncut, are worn set in finger-rings and huge earrings, and necklaces of amber and coral are also prized. The Moors consider that the risk of fraud by imitation is lessened by not having precious stones submitted to the art of the lapidary. This taste for

keeping gems in the rough also prevails among many of the Indian princes.

In 1879, thousands of British subjects from Burma passed through Bangkok on their way to the sapphire mines of Siam. The unhealthy condition of the place proved fatal to numbers, and although many realised great profits, the rush soon abated. No royalty was charged on the gems found, but a poll-tax of six shillings was levied at the mines. A sapphire weighing 370 carats in the rough, and 111 when cut, was the largest known to have been found. The ruby, onyx, and jade are also found in this district, but the quality of none of these is such as to make them very valuable.

Year by year great changes occur in the intrinsic value of precious stones from frequent plentiful discoveries. The great find of sapphires in Kashmir and Siam reduced their value some 50 per cent. The discovery of large deposits of amethysts in the interior or Brazil caused 7,000 diamond washers to abandon their usual calling and flock to the neighbourhood of the city of Caeté, but the prices dropped so rapidly that the shipments made did not pay. The diamond market has not been materially affected by any great fall in price from the enormous production in South Africa.

Art has much to do with the manufacture of gem stones. Chalcedony, when stained by metallic oxides, rises to the dignity of a gem stone, as said, cornelian, chrysophrase, when uniformly tinted brown, yellow, or green; as agate, onyx, sardonyx, when the colours lie in bands or strata. The dull or latent colours are developed by heat or roasting. Black onyx, that is, black stones crossed by bands of pure white, are always artificial.

The precious opal was formerly in high repute, but has gone out of fashion from being considered unlucky—"misfortune's stone;" and yet nothing can be more beautiful than the opals of Hungary and Queensland. The fine collection of the letter was much admired at the recent Colonial Exhibition. The area in which opals are met with in Queensland is large, but only in one or two localities are opals of any value obtained. They are remarkable for their brilliancy and variety of colour, rivalling in that respect those of Hungary. The ultramarine blue colour so finely shown in the Queensland specimens is rare even in Hungary. They are obtained of considerable size, and are of good value. Of other gems, there have been found in Queensland diamonds, rubies, sapphires, topazes, &c., in the tin-bearing drift of Stanthorpe. Agates, which are also employed as burnishers, are met with in large quantities in the Agate Creek, Etheridge goldfield. There they can be procured in all colours and sizes by the hundredweight.

In the opal mines of Dubreck, Hungary, about two miles of galleries are worked under Government supervision, yielding a revenue of £1,200. The opal-bearing rock is not disposed in vein, or bed form, on the contrary the precious stone is found in nests, or pockets, and it not unfrequently happens that a considerable distance may be passed in the workings without showing a sign of an opal.

Like some of their more civilised brethren, the Maories of New Zealand are passionately fond of adorning their persons with trinkets and other ornaments, especially of jade. At the present day many of the decorations formerly used have been discontinued. Ear ornaments are still in general use; they are worn by both sexes, and are of great variety. Those of greenstone, or nephrite, are the most highly prized. The amulet, or neck ornament, is generally of greenstone, carved into the resemblance of a human figure. The image is not unlike a Hindu idol, having an enormous face and badly-shaped legs of disproportionate size. The ear pendants of greenstone vary in form; some are narrow pieces, from 3 to 5 inches in length, and others are found thin and flat. The colour of jade varies from almost white to a dark green, but the lighter shades of green are the most highly prized. It is hunted for in the fissures of the precipices and in the streams of Chinese Tartary. Much of it is found in the rivers there by divers. These men work by moonlight, under an escort of soldiers, supervised by Government officers appointed for the purpose, and by whom each piece, as found, is assayed and valued. The imperial jade is of a brilliant green, approaching the emerald in colour.

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There are jade quarries in Burma, situated in the Mojaung district, at the head waters of the Churdwen, about 90 miles from Bhamo. They are leased to two companies for £6,000, and the trade is entirely in the hands of the Chinese.

The imports of jade into India are to the value of £30,000 to £40,000. In India jade vases are often ornamented with jewels, or carved and wrought so as to form elegant devices. The old Delhi work in cut and gem-encrusted jade is priceless. The Chinese had cut jade for ages, but never ornamented it, except by sculpture; but when it was introduced into India, the native jewellers, with their quick eye for colour, at once saw what a perfect ground it afforded for mounting precious stones, and they were the first to encrust them on jade. The Indian Museum at South Kensington possesses the choicest and grandest specimens of this work known, of the best Mogol period. (Sir G. Birdwood on "The Industrial Arts of India.")

Blocks of green stone, axes, meres, charms, and other articles of jade were shown in the New Zealand Court of the late Colonial Exhibition, evidencing the patient skill of the Maoris in working this hard material, second in this respect to the diamond, although nevertheless somewhat fragile.

Passing now from land to sea, we shall find the busy industry of search as actively carried on. In the coral fishery of the Mediterranean nearly 600 boats are employed, manned by about 6,000 men, the number to a boat varying from 6 to 12 hands. They are sent out from Torra del Greco, Leghorn, Liguria, Sardinia, and the Algerian ports. It is a curious sight to see a fleet of these boats, ranging in size from 3 to 14 tons, employed on the banks with their wooden windlass amidships, hauling up what is termed the "engine," a kind of cross-shaped dredge for tearing off the branches of coral from the rocks. About 400,000 pounds of rough coral are brought in annually to Italy, and the shaping and the working of this into the varied forms it assumes for commercial purposes, gives employment to hundreds in the chief cities. The value of the coral shipped from Europe used to reach about £600,000 annually. But with the change of fashion this has declined considerably. Not long ago there was quite a rage for the pale flesh-coloured coral for jewellery. Coral ornaments may again come into fashion, even if they do not fetch the high prices at which they were formerly sold. Coral has the hardness and brilliancy of agate; it polishes like gems and shines like garnet, with the tint of the ruby. In Russia, Northern Africa, and India coral is still much in demand. The imports into India last year were to the value of £20,000.

Amber was one of the most valuable jewels of antiquity. It was endowed with manifold sympathetic effects as a talisman against rheumatism, toothache, and other complaints. The Turks still believe it to be an infallible guard against the injurious effects of nicotine, hence its extensive use for the mouth-pieces of pipes. Amber is esteemed for ornaments by many. The cloudy, or milk-white, and the opaque lemon-coloured, are the varieties most valued by connoisseurs. The imports to this country are to the value of about £3,000 to £4,000, but it is largely shipped also to Austria, France, Turkey, and the Eastern nations. It is principally obtained on the Prussian coast of the Baltic, from Dantzic to Memel. At one establishment near Memel dredging is carried on day and night by "shifts" of men, 400 being so engaged. At another, in Königsberg, 2,350 persons and nineteen steam-engines are employed. The pits are 3?0 feet deep, and 100 carts are employed on the works. In other localities divers are employed, two to each boat, with submarine clothing and air-pumps.

The fishing for pearls and mother-of-pearl shells is carried on in very many quarters: in Lower California, the coast of Mexico, the Bay of Panama; in the Red Sea, the Persian Gulf, Ceylon, Borneo, New Guinea, the Sooloo Isles, Fiji, the Society and other of the Pacific Islands, and on the east and west coasts of Australia. The pearl fisheries on the coasts of Central Africa furnish about £100,000 worth of pearls, and employ about 1,000 divers. Our

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imports of pearls average in value about £100,000; France receives about the same. The marketable value of pearls is much higher in Asiatic countries than elsewhere, hence the best are sent to Bombay, where fancy prices are often given for good pearls.

At the Bahrein fishery in the Persian Gulf, many hundred boats are employed manned by from eight to twenty men, and the value of the pearls obtained is stated to average £1,000 yearly, but this amount of course varies. The larger and more valuable pearls are believed to be sold secretly. The men receive two-thirds of the catch, after deducting expenses, and for food, &c.

The great pearl fishery of Ceylon is carried on at stated periods on the banks of the north-west coast of the island, at the entrance to the Gulf of Manaar. As it is a Government monopoly, great care is now taken to give rest to the fishery, so as to allow the oysters to attain a maturity of five or six years, which will warrant a rich yield of pearls. There is a prospect of a good pearl fishery in 1888, and it is confidently expected that as many as 300,000,000 oysters will be fished, requiring every boat and every diver procurable in Ceylon and Southern India. The small, thin shells of this oyster (*Avicula fucata*), unlike the heavy, true mother-of-pearl oyster (*Meleagrina margaritifera*), have little or no commercial value, and are chiefly burnt for lime.

When a fishery is proclaimed, the arid sands at Arippu, on the north-west coast, becomes as it were, a bustling town of tents, filled with people of varied races and occupations, including boatmen from the Coromandel coast, pearl dealers from India, Malaya, and China, with the accompaniments of merchants and traders of all classes. The Ceylon Government takes as royalty two-thirds of the oysters gathered, which are sold by auction at the close of each day's fishing. Only a limited number of boats and divers are licensed to fish.

The fishing can be carried on only during the very calmest period of the north-east monsoon—February to April. In these months the wind blows off the land during the night, and off the sea during the day, which enables the large fleet of fishing boats to reach the pearl banks by daylight on each morning, returning with their cargoes shortly after noon. The boats, containing twenty men (half divers), are divided into two fleets, which go out to their work on alternate days. The price realised for the oysters varies from £2 to £7 the thousand, the value depending to a great extent on that of a sample of 5,000 lifted in the early part of the fishing. The contents of the mollusc being allowed to decay before the pearls can be obtained, the stench is horrible. The congregation of pearl dealers, petty traders, official subordinates, and labourers on the shores, is enormous.

About the island of Borneo there is a good deal of fishing for pearls, which are found in a thin, flat, pinkish-shelled oyster, known locally as *saksiep*. This lives only in shallow brackish water at the mouth of rivers. Several boats rendezvous at the same time and place to frighten the crocodiles and sharks. Twenty or thirty persons will be in the water at once, diving, splashing, laughing, and shouting, and bringing up three or four shells at a time; extra yells from all hands salute a rather larger find than usual. Very few of the pearls obtained are of any value individually; they are chiefly seed-pearls, which are sent to China, where they are pounded up, made into powder, and this is swallowed by ladies who desire to improve their complexion; at least, such is the story. From British North Borneo the value of the pearls exported in a year is £500. Pearls of a very high price are not infrequently to be bought at Sandakar, but they come principally from the islands of the Sooloo Archipelago. The largest ever seen there was valued at £1,600.

The formation of pearls is not limited to the bivalves, they are produced on several univalves, especially on the *Strombs* and *Turbinellas*, but are more rare in these than in the bivalves. About the Bahamas group of islands and cays the shells of the king, queen, and common conch were much sought after for sale to the cameo-cutter, but the fashion for cameo jewellery has passed

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away. The common conch is the ordinary pink-mouthed shell so frequently seen in milk shops. It furnishes the rare pink pearls, so much appreciated, and these are exported from the Bahamas to the value of about £3,000 annually. Some fine collections of these pink pearls, set and unset, were shown at the Fisheries and Colonial Exhibition in London.

It was once thought that no other pearls than those produced by the pearl oysters could obtain a rank among gems; but some of the river pearls found in species of mussels (*Unios*) compete closely with those from the mollusca of the ocean. These river pearls are found widely diffused in France, Saxony, Bavaria, Bohemia, and Silesia as well as in the lochs and rivers of Scotland, Ireland, and Wales. In China, the rivers of Manchouria furnish a good many. Delegates from the royal household look out for the best of these pearls there for the ladies of the Imperial Court.

In many of the Scotch rivers old men, women, and children may be seen wading about the shallow fords, and when they discover a collection of mussels, they thrust down long sticks split at the ends, and bring up the mussels wedged in the slots. In the shallow waters of the Dee, the boatmen look down into the water with a tin, having a glass bottom, and when shells are discovered, they are brought up by a kind of dredge, or scoop, and frequently some fine pearls are obtained.

These pearl mussels are also found in most of the small streams of the province of Quebec, and in the districts bordering on the lower St. Lawrence. The streams most abounding in pearl mussels are but little known, except to Indians and backwoodsmen, who are carefully in guarding the secret of where these molluscs are found.

Occasionally a party of pearl seekers may be seen paddling in a bark canoe, and potaging through a very wild region. After opening several thousand mussels, they will only succeed in securing a few good pearls. These vary in colour from white to dark brown; the white are appreciated for their rarity and the pink on account of their peculiar brilliancy. In form they are generally round or spherical, and have a hard skin with an iridiscent or nacreous hue.

It would lead to too much detail to pass under review the various pearl fisheries of the Australian Coasts, the Eastern Archipelago, and the Pacific Islands, where the unclothed native divers have to brave the attacks of sharks, cephalopods, and other dangers. They especially dread the stings of the jelly fish, which they say are speedy death to them. Enough has, however, been stated to show the importance of this wide-spreading industry of hunting for gems and precious stones. Fine collections of these are frequently brought before the public to feast their eyes on, as at the recent Colonial and Indian Exhibitions in London, and those at Amsterdam, Paris, and elsewhere.

At the Fisheries Exhibition in London, a firm of Parisian jewellers showed among others a very choice five-row necklace of 355 selected oriental pearls, weighing 2,570 grains; a matchless and unique necklace and parure of Scotch pearls; a very important black pearl necklace, composed of 39 pearls, weighing 1,020 grains; a round pearl of 36 grains, being one of the finest pearls known and worth £20 a grain; a very important collection of Oriental pearls, composed of 3,345 grains original, such as are most prized in Bombay, besides black, pink, yellow, and grey fancy pearls.

For further information on these topics, I may refer to my paper on "The Pearl, Coral, and Amber Fisheries," *Journal of the Society of Arts*, vol. xviii, p. 173; and to my work on "The Commercial Products of the Sea."—*Journal of the Society of Arts.*

THE PEARL FISHERIES OF AUSTRALIA.

A little while ago we were taken aback by a telegram reporting the disaster which caused so much loss of life in the pearl fisheries on the western coast of Australia, and as we think the subject may interest many of our

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readers, we reprint from the Bulletin of the U. S. Fish Commission an account of the way in which these fisheries are conducted:—

The pearl-shell fisheries of Torres Strait belong to the colony of Queensland, and are situated 1,500 miles from Brisbane and more than 2,000 miles from Sydney. Torres Strait is about eighty miles in width and separates Queensland from the island of New Guinea. The navigation of the strait, although said to be safe and practicable, is in fact very difficult on account of the innumerable islands, reefs, and shoals scattered about. The chief places at which the fisheries are conducted are Wai Weer, Albany Island, Jervis Island, Endeavour Strait, Friday Island, Prince of Wales Islands, and Possession Island.

WAGES OF THE MEN.—A good diver can earn from sixty to one hundred and fifty dollars per month. He usually signs shipping articles for a period not exceeding three years at a fixed sum per month, and has an interest in the catch or lay. Mr. Bayne, of Sydney, the owner of an important station at Prince of Wales Islands, who for many years has been engaged in pearl-shell fishing, states that several divers in his employ have earned as much as three hundred dollars per month. The divers and crews are composed of South Sea Islanders, Malays, and a few Chinese and Lascars. The diver is the captain of the boat, and the other men obey his orders. The duties of the tender consist in waiting on the diver, helping him to dress, and looking after him while in the water. The pay of the tender is from ten to twelve dollars per month, with a small interest in the catch, generally from one-sixtieth to one-eightieth part of the value of the shells. Each of the vessels generally has one diver and four tenders, who compose the crew. The tenders are engaged on regular shipping articles, and are paid off like any other merchant seamen. Mr. Henry M. Chester, the resident magistrate at Thursday Island, says, in a recent report on the fisheries, that the natives are never overworked, and that they are always well fed and kindly treated. He further says that payment is usually made them in blankets, clothing, knives, hatchets, and beads, and that whenever they are dissatisfied with what they receive they seek other employment. Mr. Chester is of opinion that the competition for their services is of such a character as to secure for them fair treatment. All the available adult population of the island are employed as swimming divers under the "Masters and Servants Act," and while their pay is small, it is made in the presence of the local authorities and all the old men, women, and children receive food in seasons of scarcity. Mr. Chester admits, however, that the occupation of a diver is dangerous, and not at all conducive to longevity, but adds that the loss of life among the natives from such causes is more than counterbalanced by the abundant supply of wholesome food given them and by the decrease in infanticide and other savage practices to which they were formerly addicted.

METHODS OF FISHING.—The method pursued in pearl fishing is for a number of vessels to start out together and fish on the same ground. Each vessel carries supplies to last a fortnight. When in about eight fathoms of water, if the tide is slack, the diver will jump overboard. His boots are heavily weighted with lead so as to hasten his descent. Upon reaching the bottom he walks leisurely along until he comes to a patch of shells; then he signals to the boat to cast anchor. He carries with him a sack or bag to hold the shells, and as soon as it is filled it is lifted up, emptied out and sent down to him again, he being able to remain under water several hours at a time. Some divers remaim down from nine o'clock in the morning until five in the afternoon. The pearl-oysters lie on the ground with the shells partly open, and great care is required in handling them, for if touched in the wrong way they will close upon the hand like a vice. Accidents of this kind not unfrequently happen to inexperienced divers, who are obliged to signal

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those above to lift them up and remove the pearl-oyster from their hands. The monsoons which blow in the strait from May until the end of September are often so severe that boats have to lay up for as much as ten days at a time. The average catch for each boat is from one ton to a ton and a half shells per month. Unlike the fisheries in Ceylon and the Persian Gulf there is little or no difficulty in collecting the shells, for they either lie loose on the ground or are only partially buried in the mud or sand. The fisheries off the coast of West Australia, and especially at Shark Bay, produce the true pearl-oyster *Avicula margaritifera*. For a long time this shell was supposed to be valueless on account of its thin and fragile structure, but now there is a great demand for it both in America and in Europe.* It is especially prized by the French and German artists for fine inlaid cabinet work. The young or chicken shell is the best, and commands the highest price. When the pearl-oyster is five or six years old the shells become blistered and wormy, and it is said the oyster dies about the age of seven years. The divers in fishing make no effort to select any particular shell, but take every one that they can get, even the dead shells, which have the least value of any on account of various blemishes, rottenness, lack of lustre, &c. Pure white silver-edged shells are the best. The oysters in the West Australia fisheries are generally obtained by passing an iron dredge over the banks, but divers are also employed. Pearl-oysters are gregarious in their habits, and whenever one is met with it is almost certain that numbers of others will be found in the immediate neighbourhood. Divers are expert swimmers, and they go down to a depth of four or five fathoms, where it is said some of them can remain two minutes. The occupation is an unwholesome one, and soon produces deafness and diseases of the chest and lungs. Blood not unfrequently flows from the mouth, ears and nostrils after the usual dip of forty or fifty seconds, which is repeated fifty or sixty times a day. The men also run the risk of being eaten by sharks, although death from this cause is not apt to occur except in untried fishing-grounds, as the noice of the divers is almost certain to drive the sharks away.

The Pearl Stations.—All the pearl-fishing stations in Torres Strait bear a close resemblance to one another, and consist of a small but nice-looking residence for the manager and one of less pretension for the men a warehouse for storing provisions, &c., and several sheds for drying the shells. Before the shells are brought to the station the boats usually run into land, and the men open the oysters, take out the pearls, if any, and throw the soft parts overboard. The shells are then roughly cleaned and stowed under the hatches. At the end of the voyage they are taken to the station, where they are counted and thoroughly cleaned. The shells are then assorted and dried, and after the outer edges are chipped off they are packed in cases, each case weighing from 270 to 300 pounds, and are ready for shipment. No systematic effort has yet been made to collect pearls at Torres Strait, and such as are found become the property of the men, who secrete them in various ways, often by swallowing them. Some very fine specimens of pearls about the size of a hazel-nut, and of remarkable beauty and clearness, have recently found their way to the market from Torres Strait. Other specimens of a much larger size have been found there, but they were imperfect in shape and colour.

Formation of Pearls.—In oysters aged four years—which are judged by the shells, weight and appearance—the best pearls are found. The shell, like the pearl, is formed by the secretion of the animal, and is composed of animal matter and lime. The iridescent hues on the inside of the shell are occasioned by the edges of the thin, wavy, concentric layers overlapping

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* Some mistake, or the Australian shells must be superior to those of Ceylon, for which there is now no sale.—Compilers.

one another and reflecting the light. The minute furrows containing translucent carbonate of lime, produce a series of more or less brilliant colours, according to the angle at which the light falls upon them. Occasionally some of the finest pearls are found loose in the shell. As many as one hundred pearls have been found in one oyster, but of little or no value. The pearls of the young oyster are yellow, and in the older oyster are of a pinkish hue.

THE USE OF PEARL-SHELLS.—The pearl-shells shipped from Australia to the United States and Europe are used principally for the manufacture of knife-handles, shirt-buttons, &c.* Considerable quantities are also used for papier-mâché, and other ornamental work. The pearl buttons, shirt-studs, &c., now made in the United States, are said to be the best and cheapest in the world, a fact due in great measure to the care used in selecting the material and to the improved methods of cutting.—*Field.*

CUBIC CRYSTALS OF GRAPHITIC CARBON.

In the analysis of a meteoric iron found in 1884 in the sub-district of Youndegin, Western Australia, and of which two of the four fragments have been generously presented to the British Museum by the Rev. Charles G. Nicolay, Curator of the Geological Museum, Fremantle, I have obtained some crystals, a description of which may be of interest to the students of carbon.

The crystals were obtained as an insoluble residue on treatment of 8·3200 grammes of the iron with aqua regia: they are bright, opaque, grayish-black, have a metallic lustre, and present forms belonging to the cubic system. As their characters were not recognized as belonging to any known mineral, it seemed unlikely that the nature of the crystals could be completely determined, seeing that the total weight obtained was only 3 milligrammes: further, two fragments of the iron, weighing 2 and 7 grammes respectively, had not yielded a single crystal, and there was thus a possibility of their being so localized in the iron as to render impracticable an increase of the quantity of material available for experiment.

The crystals were about a hundred in number, the average thickness of the larger ones being 1/100 of an inch. Many of them are sharply defined cubes; some have their edges truncated by the faces of the dodecahedron; in others the edges are replaced by rounded faces of a tetrakishexahedron.

Their hardness is greater than that of rock salt and less than that of calcite: the streak is black and shining. Of four crystals, two sank to the bottom and two remained near the surface of a solution having a specific gravity of 2·12. The crystals are unaffected by acids; heated in a combustion-tube in a current of oxygen, hydrogen, or chlorine, they are unattacked even when the glass begins to melt. Heated in a platinum capsule with the table-blowpipe, they slowly disappear without flame. Heated with potassium nitrate in a crucible over a Bunsen burner, they are unaltered; but disappear very slowly, without deflagration, when heated with the table-blowpipe.

In density, colour, and streak, and in its chemical behaviour, the residual mineral thus bears a close resemblance to native graphite, but it is considerably harder, and it presents itself in well-defined crystals which belong, like those of the other crystallized form of carbon, the diamond, to the cubic system: terrestrial graphite, when crystallized, is found only as tabular crystals so indistinctly formed that doubt has long existed as to whether they should be referred to the hexagonal or monosymmetric system.

In a paper entitled "Graphite pseudomorphous after Iron Pyrites," Haidinger, in 1846, described some graphitic crystals which were doubtless

* The large mother-o'-pearl shells are now meant, but the writer confuses the two species.—COMPILERS.

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similar to those furnished by the Youndegin iron: his observation, however, has been forgotten, and is without record in modern meteoric literature. The crystals—of the size, number, and completeness of which Haidinger makes no mention—were obtained by him from a nodule of grapihte which had dropped out of the Arva meteoric iron, and chiefly from a study of their form he inferred that they were pseudomorphous after iron pyrites. Even yet no iron pyrites, crystallized or massive, has been found in a meteorite, the meteoric sulphide of iron being, not the bisulphide, but the protosulphide: further, Gustav Rose, after examination of the crystals, expressed the opinion that the replacement of the edges of the cubes was suggestive rather of holosymmetry than of hemisymmetry, an interpretation which would exclude iron pyrites as a possible antecedent mineral.

The Youndegin graphitic crystals support the view entertained by Rose: The existence of the dodecahedron face, of which there is goniometrical proof, is of itself quite sufficient to show that the crystalline form is distinct from that of iron pyrites.

The iron pyrites theory being discarded, and the fact being recognized that no mineral constituent of meteorites has yet been found which crystallizes in forms similar to those of the graphitic crystals, there naturally arises a feeling of doubt as to the correctness of the view according to which they are of pseudomorphic origin, and thus a question as to whether they may not possibly be a third allotropic condition of crystallized carbon presenting the general characters of graphite, but a crystalline form frequent in the diamond.

Bischof denies the possibility of explaining the pseudomorphism of terrestrial minerals by any other process than the slow action of water, of which there is no evidence in meteorites; and though it would be unsafe to argue that only in this way could meteoric pseudomorphs be produced, there is sufficient difficulty in their explanation to demand strong evidence before pseudomorphism of the graphitic crystals is granted, more especially when we have regard to the fact that no other graphitic pseudomorph has yet been established either in meteoric or in terrestrial minerals.

Examination of the Youndegin crystals under the microscope shows that some of them are hollow, and appear to be built up of successive cubical shells: on several of the crystals there are globular growths covering a large part of a cube-face, and occasionally the globule is broken, and is seen to be merely a thin, now empty, shell, of which the bottom is the face of the cube. The crystals are easily frangible, and no cleavages were observed; they appear to be quite homogenous in their material.

Although some of these characters suggest a pseudomorphic origin of the crystalline form, it cannot be said that they prove it. Both of the recognized crystalline forms of carbon, graphite and diamond have long been standing difficulties for the crystallographer. As already pointed out, the crystals of graphite are rarely more than mere tables, of which there is a controversy as to the crystalline system; those of the diamond are often so different in their geometrical characters from the crystals of every other known substance, that it cannot be satisfactorily determined whether they are to be referred to a holosymmetric or to a hemisymmetric type.

Hollow and skeleton crystals are often the result of a hurried crystallization as is so well seen in the artificial crystals of bismuth and of common salt. The diamond, too, when in cubes, has faces more uneven than those of the Youndegin crystals, and shows usually the same replacement of its edges by rounded faces of tetrakishexahedra.

It thus might be argued with some force that the Youndegin crystals have been the result of a hurried crystallization of carbon, and that, while striving to reach a dignity which has been assigned to cubes of diamond, they have been overtaken by misfortune and come out in cubes of the less honoured mineral, graphite. The obtuse, almost flat, square pyramid seen on some of the cube-faces, the hollow globular growths, the occasional parallelism of the group-

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ign of the cubes are distinct, however, from what is met with in the diamond.

And after consideration of all the observed characters of these crystals it will be seen that the explanation of the occurrence of the crystals in the interior of a mass of iron by means of pseudomorphism is untenable. Though the easy frangibility, the absence of evidence of cleavage, the hollowness, and the occasionally crust-like structure, are more or less characteristic of pseudomorphic crystals, they are not incompatible with an independent crystallization; on the other hand while the superior hardness distinguishes the crystals from those of native terrestrial graphite, the separateness, completeness, and general excellence of the crystals, the delicacy of various acicular projections, and more especially of the obtuse, almost flat, square pyramid seen on some of the cube-faces, are sufficient to prove that the crystalline form never had a previous tenant. The delicacy of the acicular projections is such that the crystals must have been formed *in situ*. In case of pseudomorphism, the elements of the original mineral ought to be in the vicinity of the crystals; and there ought to be an excess either of the original mineral or of the replacing amorphous graphitic carbon: both are, however, conspicuous by their absence, and in this fragment of the iron the whole of the graphitic carbon is present as cubic crystals.

On examination of a large graphite nodule from the Cocke County meteoric iron, now in the British Museum, crystals of graphitic carbon, cubo-octahedral in form, are to be seen in some of the crevices.

There can be absolutely no doubt that the graphitic crystals are the result of crystallization of the meteoric graphite, and that they represent a third allotropic condition of crystallised carbon, the general characters being those of graphite, and the crystalline system that of the diamond.

As this form of graphitic carbon is unknown among terrestrial minerals, and has so important a bearing on the formation of meteoric graphite, it may conveniently receive a special name; I suggest the term "cliftonite," after Prof. R. B. Clifton, F.R.S., who has long been interested in the physical characters of minerals, and has done much to encourage their study.

A full description of the meteoric iron itself and of the graphite crystals will appear in the forthcoming number of the journal of the Mineralogical Society.—L. FLETCHER.—*Nature.*

METEORIC GRAPHITE: A LINK BETWEEN CHARCOAL, TERRESTRIAL GRAPHITE, AND THE DIAMOND.—We give above a curious paper on graphite of meteoric origin. The writer of scientific gossip in the Melbourne *Leader* thus notices this substance which has come to our globe from the realms of space:—

It is well-known that graphite is a form of carbon intermediate between charcoal and the diamond, and a curious link between the three has just been discovered. Graphite has heretofore been regarded as amorphous; but Mr. Fletcher, while analysing some fragments of a mass of meteoric iron which fell in Western Australia, made the discovery that the graphite contained in it was csystallised and of the same form as the diamond. It is not known that any similar mineral exists anywhere on the face of the earth, and much curiosity is felt as to how the charcoal of the meteorite became crystallised. The meteoric graphite is harder than the terrestrial article, although there is very little difference in density, color, and streak. The question has been asked whether meteoric graphite may not be a new allotropic form of carbon, and no answer to the question has yet been given—there is merely a probability that this may be the case. It is a tempting speculation to imagine that the meteoric graphite is in a state of transition, and that the crystallisation in cubes shows that it is more allied to the diamond than to the usual form of graphite. Looking to the softness

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of the crystals as compared with the diamond, it is difficult to believe in this theory. The hardness is intermediate between that of gypsum and that of calcite. Some of the crystals sink in water and others float. The discovery is of considerable scientific interest, but as yet of no commercial or industrial value. All previous researches favor the idea that the diamonds are of vegetable origin, and that the transformation of the carbon takes place in the soil where the diamonds are found. This, however, is not an explanation, as it merely indicates the direction in which one may be looked for. Crystals, as a rule, are not formed or modified from or by materials in the solid state, and it is reasonable to suppose that there must be some intermediate liquid or plastic form of carbon which has not yet been found. The existence of organic remains imbedded in the diamond renders it improbable that heat has been an active agent in its production. It does not follow, however, that diamonds may not be capable of formation in many ways. All that can be said is that those dug out of the earth are not the products of heat. It can scarcely be said that there is any theory at all of the mode of their production.

THE CEYLON PEARL FISHERY OF 1881.

The Pearl Fishery of 1881 was one of the most successful, as the result shews, of any held for a great many years back. The net receipts (£59,868) have not been equalled since 1814. This was very much due to unusually fine weather, and the very good prices offered for the oysters. Much is also due to Capt. Donnan's and Mr. Twynam's admirable management of the Fishery, and we think some special acknowledgment ought to be made of their valuable services. Capt. Phipps, Master Attendant and Superintendent of Fisheries at Tuticorin, receives from the Indian authorities, one per cent of the results of any Pearl Oyster Fishery he may direct. Seeing that this year the divers had an increased allowance—another cause probably of the success of the Fishery—we think Capt. Donnan ought also to have special acknowledgment, and no one in the Colony would grudge a bonus of R2,000, which would be less than half of the Indian allowance.

We regret to say that there is no prospect of a Fishery for next year. There is no supply of oysters ready, and the prospects of the future will be determined in March next when a regular inspection of the coast from Chilaw to Mannar will be made.

It will be observed that considerable gaps—intervals with no fisheries—are experienced. But this was equally the case in the time of the Dutch, who from 1732 to 1746 had no fishery, nor again from 1768 to 1796. Within the British era of 68 years, no less than 50 years are blanks so far as Pearl Fishery receipts are concerned. But during the remaining 36, the net return in hard cash has aggregated over a million pounds sterling to the Colonial revenue. The usual mode of dividing the epochs of Fisheries is as follows:—

1st Series	1796	to	1809	yielded	£517,481
2nd „	1814	„	1820	„	£ 89,909
3rd „	1828	„	1837	„	£227,182
4th „	1855	„	1863	„	£166,470
5th „	1874	„	1881	„	£117,900
					£1,117,992

The total expenditure against these receipts equals £147,000, and a large portion of this amount was incurred between 1864 and 1869 through the employment of a special Naturalist, Mr. Holdsworth, to report on the then unaccountable disappearance and failure of the oysters, but this gentleman added only one fact of importance to our knowledge, namely that our pearl oyster (*Meleagrina margaritifera*) differs from that of the Persian Gulf (the *Pinnaeus*

placenta),* and he made no practical suggestion of any value. Previous to his advent Master-Attendant Steuart and Dr. Kelaart had paid a good deal of attention to this subject, the latter first reporting that the peral oyster was capable of detaching its byssus and moving from place to place. In our own time Master-Attendant Donnan as Inspector of the Pearl Banks has, through careful observation, acquired a practical experience surpassed by no living authority on the subject of Pearl Oysters and Pearl Fisheries. For some years it was supposed, and Mr. Holdsworth supported the idea, that the action of currents carrying muddy deposits over the banks of young oysters, accounted for the lapse of fisheries, but Captain Donnan has disproved this opinion. He says:—"In my experience I have never found the slightest trace of mud being carried over the banks. The bed of the banks remains undisturbed as evidenced by the fact of a tank, which was sunk on the banks with some young oysters in it to test their growth in 1867, having remained undisturbed to this day. The tank embedded itself about a foot in the sand, and I have had it examined every year since, and it remains the same, no further accumulation or washing of sand round it." But all the experience gained, and all we have learned about the terribly destructive action of skates and other enemies, has failed to shew us any means of turning a fitful and uncertain into a regular and continuous source of revenue. Capt. Donnan has, however, acquired much practical knowledge as to the porper age at which the oysters should be fished; he has reduced the inspection of the banks to a system; and he shows in the case of the Ceylon oyster banks the danger of waiting too long equally with that of fishing too early; the proper age being generally between the fourth and sixth year, but the oysters are liable occasionally to get detached and to disappear altogether after five years. The fishing of any one particular bank must, however, be guided by circumstances, and the results of careful inspections held twice a year: this was well shewn in the case of our last two Fisheries. The outturn of pearls in the sample taken in November 1879, proved that the oysters were too young for fishing in the spring of 1880, but then there were such an enormous number of oysters on the bed—more than could possibly be fished in one year—that it was decided to fish a portion of the bank during that season rather than run the risk of losing them if kept another year. The oysters fished in 1880 were 4½ years old, and 26 millions of them only yielded one-third the amount that the remainder, 18¼ millions, kept for fishing in 1881 and consequently 5½ years at the time of fishing, gave. This, however, cannot always be taken as a criterion, for the oysters fished in 1874, 1877, and 1879, were only 4 years old; and gave better results than the oysters fished in 1880, which were six months older.

Considering the half-million of pounds sterling netted during the first 14 years of British occupation, it was no wonder though Ceylon should be regarded as an Eldorado worthy of being kept in exchange for Java by the English authorities at the peace of 1815; but alas!—possibly through over-fishing and careless management in those early days—all the fisheries since 1809 put together make up no more than an equivalent sum to that obtained by our first two Governors—the Hon. Frederick North, afterwards Earl of Guildford; and General Sir Thomas Maitland, the "King Tom" of Malta and Ionian Islands celebrity. Governor Sir Robert Brownrigg, the conqueror of the Kandyan Kingdom, received one windfall of £100,000 in 1814; and then there was a blank until, in the four closing years of Sir Edward Barnes' prolonged and brilliant administration, £120,000 was received. This good fortune continued throughout the time of Sir Robert Wilmot-Horton—one year, 1834, alone being blank—and the Pearl Fishery gave this Governor altogether

* Capt. Donnan has, however, seen some Persian Gulf oyster shells, between which and the Gulf of Mannar oysters he could see no difference.

£113,000 of revenue. Then came a long blank of eighteen years until the advent of the great successor of Sir Edward Barnes, and one notable aid to Sir Henry Ward's expenditure in the Colony was undoubtedly found in the £140,000 derived by him from Pearl Fisheries. But "bluff Sir Harry"—the Governor distinguished *par excellence* by the "drab hat"—knew how to invest money to advantage, and he nearly doubled his revenue by liberal, judicious expenditure. A change for the worse came with Sir Charles MacCarthy, whose one windfall of £51,000 in 1863 simply went to swell Mr. Cardwell's appropriation of local revenue for so-called past-due Military contributions. It is noteworthy that the yield in 1863 was the largest in any one year since 1814, until the splendid return of £59,868 came from the present year's fishery. Sir Hercules Robinson did not receive a rupee from the Pearl Fishery, and Sir Wm. Gregory only £10,140 in 1874, and about £19,000 during the year he left, which fell properly to his successor. Sir James Longden has therefore to be debited with the proceeds of four Pearl Fisheries—aggregating £108,000, against £30,000 of expenditure.

The expenditure has of recent years averaged £8,000 per annum when there is a Fishery, and less than £5,000 without Fishery expenses. The Ceylon Pearl Fishery Establishment consists of 1 Superintendent (the Government Agent for the Northern Province); 1 Inspector with an allowance of R1,000 (the Master Attandant, Colombo); 4 Coxswains of inspection boats, 16 Divers, and 16 Munducks (Divers' attendants); and 1 Steam Launch and her crew. During Inspections and Fisheries, a native craft is chartered for the establishment to live in. The Inspector conducts inspections and determines when a bed should be fished, and directs the fishery of the same. The Superintendent conducts the operations of the Fishery on shore, sells the oysters, &c., but has nothing to do afloat. The divers employed during the Fishery supply their own boats, and these are arranged in squadrons, payment being made by a certain proportion of the oysters fished. The Ceylon (Arippu) Fishery usually takes place in the months of March and April, when the sea is calm and the currents least perceptible. The boats assembled are numbered and divided into two squadrons, the Red and the White, each consisting generally of 60 or 70 boats. The squadrons fish alternately. Each boat has its Tindal and Today or water bailers and a guard, five diving stones, and two divers and two munducks to each stone. The squadron starts, usually, between 11 and 12 p.m., so as to reach the fishing ground by sunrise; the banks are about 12 to 16 miles from the shore. On their return from the banks, as the boats reach the beach, they let go their anchors opposite the Government "Kottu." When the oysters are landed they were divided into four heaps. In two hours the whole of the 75 boats are unloaded, the divers' share removed and *three-fourths* belonging to Government left in the Kottu, piled into heaps and numbered corresponding to the number of the boat from which they were taken; the doors are locked, guards stationed, and everything is in readiness for the Kachcheri sale.

It will be observed that the prices paid for the oysters differs greatly in different years. Thus, less then three millions of oysters in 1860 yielded three times the amount that 26 millions did during 1880! The average price realized (£12 17s per 1,000) in 1860 was however quite unprecedented. Of course a good deal depends of the age and character of the pearls, but sometimes, as in 1879, and again during last year, the native traders who assemble at Arippu from different parts of India and Ceylon combine to try and keep down the price and sometimes with partial success. The Ceylon Government derives a small amount—a few thousands of rupees—annually from a fishery in the Tambalagam lake near Trincomalee, but the oysters in this case (the *Placuna placenta* of naturalists, the same as that said to be found in the Persian Gulf and China Seas) is not the true pearl oyster (*Meleagrina margaritifera*) of the Arippu pearl banks.

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The pearl banks close to the shore of India and Tuticorin have yielded very insignificant returns to the Indian Government, and a prolonged experiment in conserving certain banks and in the culture of the oyster by Capt. Phipps, has not been attended with success. The pearl oyster fisheries in the Persian Gulf have long been in repute: the annual yield was lately said to be £300,000 (query 300,000 rupees) in value. More recently—during the last dozen years or so—pearl fisheries have been developed on the north-west and northern coasts of the Australian continent, and "pearling," as it is called, now gives employment to considerable fleet of boats owned by colonists who employ Malays or Australian aborigines as divers. Very fine pearls of both a pale-white and straw colour have been obtained off Western Australia, some of the finest pearls being extracted from the very large shells of oysters found in that quarter.* And now that both the West Australian and Queensland authorities have become interested in these Fisheries, we should most strongly advise them to get such practical reports on the best mode of conserving the available banks and arranging for systematic Fisheries as the Ceylon Inspector of Pearl Fisheries, Captain Donnan, for instance, could so well furnish. They ought to take warning by our Ceylon experience of the danger of careless and persistent over-fishing. But the principal trade off the Australian Coast is in exporting the shells to Europe, to be worked up for "mother-o'-pearl" purposes. During the present "pearling" season, it is reported that two or three boats have secured as much as 30 tons of shells each. Shells from the Ceylon Fishery have also of recent years been consigned to Europe, the demand being very much for Continental gaols, where the prisoners are employed manufacturing buttons, &c., out of the nacre, but the trade has not proved profitable, and is now given up. The latest London Market Report (May 26th 1881) on sales of Pearl Shells is as follows:—"At

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* The *Scientific American* has the following:—"CONCH PEARLS.—Most of our readers have doubtless frequently seen and admired the delicately tinted pinkfaced shells which are extensively used for bordering garden-walks and other ornamental purposes; but few probably are aware that in the conch which inhabits this shell is occasionally found a very lovely gem, known to lapidaries as the conch pearl. When perfect, the pearl is either round or egg-shaped and somewhat larger than a pea, of beautiful rose colour, and watered; that is, presenting, when held to the light, the sheeny, wavy appearance of watered silk. It is, however, a very rare circumstance to find a pearl which possesses all the requirements that constitute a perfect gem, and when such does happen it proves an exceedingly valuable prize to its fortunate finder. Pink is the most common and only desirable colour, although white, yellow, and brown pearls are occasionally found. Even among the pink ones there is usually some defect which mars their beauty and materially injures them; some are very irregular in shape and covered apparently with knobs or protuberances; others are too small, while many lack the watering, which gives them their great value and chief beauty. The conch abounds in the waters of the Bahamas, and thousands of them are annually obtained and destroyed for their shells, which form quite an article of commerce, but in not one conch in a thousand is a pearl found. When this is taken into account, and the other fact, that not more than one in twenty of pearls found turns out to be perfect, it will at once be seen that a good conch pearl will always be a rare and costly gem. In fact, their value within the last few years has almost doubled, and the demand for them is steadily increasing. Most of the conch pearls found in the Bahamas are exported to London, where they are readily sold."—During a visit we paid to Perth, Western Australia, in 1875, we saw very large pearls cleverly cut out of the inside of shells (specimens of which we have placed in the Ceylon Museum), but they were not equal in quality to the Ceylon pearls.—COMPILERS.

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the sales held on the 10th inst. a fair general supply was offered, and with a steady demand a good portion was sold at nearly former prices generally, but small shells were again rather cheaper. Bombay.—Of 135 packages offered, 80 sold at about last sales' rates: medium to bold £5 to £5 2s 6d; 2 cases fine color £5 17s 6d; small medium clean £5 5s to £5 10s; chicken fine color clean £5 5s to £5 12s 6d; oyster and thin part broken 80s to 95s; blistered pickings 35s to 46s per cwt. Zanzibar.—35 packages sold at previous prices: good medium to bold 57s 6d to 62s 6d; small medium 47s 6d; oyster and thin 30s to 35s. Egyptian.—Of 220 packages offered, 157 sold, bold at about last sales' rates, and small sizes rather cheaper: medium to bold 95s to 102s 6d; dull yellowish 87s 6d; small medium clean £5 2s 6d to £5 7s 6d; chicken £5 5s to £5 7s 6d; chicken and small medium dull color 92s 6d to 97s 6d; oyster 90s to 100s; broken pieces 45s to 75s; dead and blistered pickings 19s to 30s per cwt. Mussel, again in large supply and good demand, of 1,500 packages offered, 866 sold at about previous rates: good to find bold 35s to 71s; fair sorts medium to bold 42s to 57s 6d; do. small to medium 30s to 35s; do. small and thin 21s to 29s 6d per cwt. Next sales 5th July"—As much as £28,268 worth of "precious stones and pearls" were exported from Ceylon during 1878, about £6,000 worth in 1879, and £4,500 in 1880.

THE FISHERY OF 1881.

In view of the increase this year from one-fourth to one-third as the share of boatmen and divers of the oysters fished, the receipts of the latter must have been very satisfactory, equal in aggregate value to at least one-half of the Government revenue. Capt. Donnan agrees with us that the divers, boat-owners, &c., got quite R300,000 (£30,000) out of the last fishery in something like the following proportions:—

200	boat-owners	at R250 each	... ...	R50,000
600	boatmen	„ 30 „	... ...	18,000
1,000	divers	„ 160 „	... ...	160,000
1,000	munducks	„ 72 „	... .	72,000
				R300,000

These returns for 50 days' work must have been considered very satisfactory by those concerned. The oysters fished in 1881 were valued in Nov. 1879 at R6·43 per thousand, and in Nov. 1880 at R21·37 per thousand; nearly 3½ fold increase in the 12 months. This, together with much greater competition at the recent fishery accounts for the prices realized as compared with the fishery of 1880.

It is quite true that the oysters of 1874, 1877, and 1879 were younger than those of 1880, and yet fetched better prices. The oysters of last year and this year's fishery have been a puzzle to Capt. Donnan from first to last, and he is now led to believe that there are two kinds of oysters that breed on our beds, one coming to maturity sooner than the other, and this may probably account for some of the mistakes made in judging of the age of oysters in former years.

FULL REPORT ON THE PEARL FISHERY OF 1887.

(By the "Ceylon Observer" Special Representative, Mr. A. M. Ferguson, C.M.G.)

Silavatturai, 3rd April 1887.

We started in the "Serendib" from Colombo about 5 on Friday afternoon, and while we were waiting, some children on board had the opportunity of seeing the diving performances and bodybeatings of four demon-like very black boys who came to the steamer's side on a catamaran. Two of the boys were

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so long under water before one of them triumphantly brought up a 12½ cent piece, that I should like to know the depth they go down to and what the difference of temperature between the surface and lower waters may be. For, the pearl fishery divers find it to be so cold at six to eight fathoms (36 to 48 feet)—the depth at which the oysters are generally found to exist in greatest abundance and healthiness,—that they (the divers are glad to warm themselves in the sun for a while after coming up from the performance of ther task. In my telegrams I have mentioned the cases of two divers whom Mr. Twynam saw die from remaining too long under water, and I have suggested, as the cause the non-aeration of the blood, or what has lately been noticed as a cause of drowning, the sudden collapse or paralysis of certain muscles and nerves. The so called "Arab diver" who was timed by us to 83 seconds, differed from others in putting a compressor on his nose and he was noticed to open his mouth widely and inhale air in large volume before going down with his stone and basket. He brought up, or rather he collected in the rimmed net bag which he had round his neck until he filled it, and which, like the stone, was hauled up separately, 42 oysters, which was considered a very good haul. All the divers when they come up seem glad to inhale a good gulp of air, but they do not or only very rarely and temporarily show signs of distress. Of the two fatal cases noticed by Mr. Twynam, one was a novice who, no doubt, miscalculated what he could bear, from want of experience. The other was a practiced diver, but he may have had organic disease. Captain Donnan states that he has never known the divers take anything to help them except snuff! Mr. Twynam once induced a diver to go to the bottom in 15 fathoms (twice the average depth on the pearl banks) but he was so alarmed at the prolonged period from the man's diving to his re-appearance, that he has not and never will repeat the experiment. The great difficulty in artificially propagating the pearl-bearing mussels and the reason why all experiments here and in Southern India have failed, is the depth, 6 to 8 fathoms at which alone this species of shell-fish seems to flourish. At that depth

Life in a thousand beautiful forms,
 Is sporting amidst those bowers of stone,
And is safe when the wrathful spirit of storms
 Has made the tip of the waves his own.

The beauty of some, such as corals and star-fishes and the singularity of other "by-products" of the pearl fishery, which are generally cast back into the sea, are striking. There was a strange creature, half earth-worm, half centipede, which went to pieces while we were examining it. But the amazing thing is the vast amount of corals, sponges and other zoophytal and fungoid growths which cover the pearl shells of 3½ years old. I wish I was naturalist enough to identify the striking red-coloured masses of vegetable matter which cover the shells and give one the idea of a laterite bottom, where there is only sand and coral.* The more rock and the more coral the better and there is sometimes much competition not only for oysters from certain banks, but for shells from certain rocky portions of banks. The formidable, hammer-teethed skates have been at their destructive work on the banks and so have "the old woman fishes." Why so called, no one seems to know, the marked peculiarity of the fish being long fins or tentacles, which can be bent half or full cock like the trigger of a gun! If only a bit of the shell of an oyster is broken by enemy or accident, an army of small voracious whelks speedily invades the interior and eats up the animal which, Capt. Donnan believes, only uses excess supplies of nacre to commence and build up pearls, film upon film, so as to give them their exquisite iridescence. Minute fragments of foreign bodies are sometimes found as nuclei, but often no sign of a nucleus can be discovered. Capt. Donnan once found a small pebble which had slipped into a fish enamelled with nacre. Surely this is suggestive, although it is quite a different species of shell-fish, the Chinese utilize to give a nacre covering to idols and ornaments.

* The red disappears in decomposition.

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There are two divers to each stone, who are alternately up and down. We saw on board the guardship (one of the immigration vessels, a fine 250 ton ship with three tall masts) a stone made of our common gneiss rock, and a specimen of some substitutes made of concrete at the breakwater. The weight seemed to be from 30 to 40 lb. The weight of the stone helps to carry the diver rapidly down, and as I have said, he has the net bag for the shells slung round his neck. On touching ground the diver detaches himself from the stone which the force of hauling coolies on each fishing boat proceed at once to pull up. Others haul up the basket when the diver casts it off and gives the signal of a jerk to the rope. The diver himself has only to give play to his buoyancy to rise, but he is careful to avoid contact with the boat and will often dash off horizontally outwards in coming to the surface, which he does almost simultaneously with the bag of oysters he has gathered. While he holds on by the side of the boat, the contents of his net bag are emptied into large ola baskets, foreign substances being thrown back into the sea, the net being soon again ready for use. In each boat we found a belted native "counter" who responded to the question "etena chippee?" but I noticed that Mr. Twynam always added a percentage to the number given. It seems as if the exact truth could not be stated: indeed, I fancy that a good deal of fairly correct estimation goes for counting in the division of the spoil finally. The people, however, divide the oysters into fairly equal heaps because they knew not which heap may be allotted as the boat's share. The boat now gets a third instead of the ancient fourth, which latterly was found not to be a sufficient inducement, and Mr. Twynam's calculation is that each man of some 2,300 employed in the boats yesterday, made about R3 wages.

The boatmen and divers' shares of oysters can at once, on division, be sold, so that the people employed have whatever advantage may accrue from being first in the market. At the Government auction last evening it was amusing to hear one man allege that he did not purchase as Saturday was an unlucky day! Another said people would blame him if he bid; a man in the background said he did not want people to know what he was bidding; while a bidder up to R25 said emphatically, "I 'll not bid higher." Some were at work all night carrying away their lots of oysters, but a walk I took early this morning over shells and fragments of shells everywhere, shewed that the work of washing except in the case of a few small retail purchases, had not yet commenced. The demand here for ola mats and baskets and for cadjans and palmyrah leaves is very large, hundreds of temporary abodes going up in all directions. Some of the houses are just large enough to creep into. The "Serendib" did not bring police from Colombo, as Mr. Twynam was able to get a force from Jaffna. But I must hark back to the "Serendib," which I found a very complete, well-ordered, and clean vessel, up to 7 knots. The view of the breakwater, town, and shores as we went northwards was very striking; so were the flashes of the lighthouse, and the incessant blazing of lightning which succeeded, and which the Captain referred to the Madulsima mountains. There are distant rumblings of thunder here now, but no one seems to dread rain or to hope for it. Climate and soil are against vegetation here; but the bay, bounded on one side by Kudiraimalai (well-known to the Greek and Roman voyagers as *Hippouros*), is very spacious and pretty. But there are a good many rocks scattered about. You may imagine our excitement when on the morning of yesterday early we saw the fleet of graceful-sailed boats sweeping along the horizon and making for the banks. They reminded me somewhat of the sardine fishing vessels I saw in the Mediterranean.

Silavatturai, 5th April 1887.

You will recollect the dry beds of rivers scoring the mountain sides in Sicily. Similar dry river beds are quite common in Australia, and a man on a good horse can there gallop abreast of a perfect wall of water, the result of floods in the mountain sources of the stream, until the thirsty sands have

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absorbed the water long before the sea is reached. Here in the north of Ceylon quite a number of rivers besides the Kalaar, or rather Kalaru, down which Robert Knox and his companion escaped from the power of the Kandyan tyrant, present similar conditions of roaring down in flood at one season of the year and being dry or only dotted with waterholes at another, the dry season. Poor Sandy Brown had experience of these rivers in floods when, with a Frenchman named Grandidier, he visited the pearl banks and recounted his adventures in the *Observer*. Mr. Twynam, who I suppose has walked not only over the highways and byeways of his large Province, but also through the recesses of every jungle which conceals an irrigation work, once followed in Knox's footsteps down the bed of the Kalaru. He so frequently sunk some distance in quicksands, that he does not recommend pedestrianism over dry river-beds to ordinary human beings susceptible to heat and fatigue, which his own iron constitution set at defiance. The joke about the Government Agent of the Northern Province is that if any person wishes to secure "master's favour," he will give him the chance of ten to thirty miles of a hot walk over loose sand and through dense jungle, by reporting the position of one of those almost innumerable bunds of irrigation tanks, which the Sinhalese in the palmy days of their rule in Anuradhapura, scattered over the north and east of Ceylon, and which the "Damilo" invaders took a demoniac pleasure in scattering into ruin, salubrity and population disappearing as the result of broken bunds and water run to waste. Certainly since this pearl fishery commenced, no person present has worked harder, in longer spells, or with less regard to the comforts of regular meals or the necessity of sufficient sleep than Mr. Twynam. The Government Agent in his capacity of Superintendent of the Pearl Fishery, has to initiate, watch over and guide all the proceedings, listening patiently to complaints (some of them childish), and rendering help to those who cannot at once hire coolies or obtain long jungle sticks for their private "kotoos." In these private "kotoos" alone, situated at a good distance from the inhabited portion of the town, are the pearl shells allowed to putrefy and be washed. The Government enclosure is simply used for the reception of the oysters from the boats, the counting of them, which I now find, is most carefully done and the division of the Government and boats' shares. As soon as the latter are defined, and that is within a very short period of the arrival of the boats, the shells are instantly carried away and retailed to the crowds who are waiting to buy in larger or smaller lots. Even up to this morning, the fifth of the fishery, the only openings, washings, and searches for pearls have been by purchasers of these small lots. The large purchasers are gradually ripening for the harvest, the blue bottle flies instinctively resorting to what they recognize as fitting food for their young, and soon there will be such a scene of life-in-death, as beggars all power of description. The hideous odour, which has left a coppery taste on my palate makes me glad that no official duties bind me to remain beyond tomorrow morning, but that I am at liberty at length to realize a dream of my life by having a look at the Giant's Tank, the Rock Temple of Dambulla, and the great "Buried Cities" of Ceylon. I would bestow pity on those who remain, but for the fact that I suspect they would resent any misplaced sympathy. The gentle and delicate lady who adorns herself with a necklace of those sea-born gems, which are, of all others, most emblematic of all that is chaste and pure, would be shocked and horrified beyond measure, were she to see and especially *smell* the mass of decomposing and moving putrefication, out of which the lustrous pearls in her necklace were evolved. But the officials and all connected with the fishery seem to have adopted Vespasian's principle, that the money realized does not smell. I have it on Mr. Twynam's authority that it is no uncommon circumstance for the people interested in lots of putrefying oysters, *to sleep comfortably over the reeking mass*. The truth seems to be that the smell of the decomposing oyster-flesh, however horrible to ordinary olfactories is not really prejudicial to health, and that all concerned are aware of this and when, to use the Scotch phrase, they "feel the smell," they turn their noses to windward and say "Who 's afraid?"

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It stands on record in the annals of the Pearl Fisheries of Ceylon that one European official not only did not object to the powerful smell, but welcomed it as an appetizer! It is now, I believe, established that the origin of much of the fever called "malarious" is due not to the decomposition of animal matter but to the decay of very minute vegetable forms. I suspect that the diarrhœa, dysentery, and cholera at former fisheries have been due not to the putridity of oyster-flesh, but to the neglect of the first laws of sanitation, which the mass of the natives will violate, if permitted. What abominations they are capable of, I saw this morning in a walk to the jungle beyond what I may call Mr. Twynam's municipal limits. In olden days the people drank polluted water, which is undoubtedly the great pre-disposing cause of cholera. Now the utmost cleanliness is enforced, all extraneous matter is being constantly swept into heaps for burning or burying, and there is a series of wells along the beach yielding excellent water, while others are still being dug. It is a pleasant sight to see crowds of the people around the walls of the wells, pulling up water and washing their persons and their clothes. The shower on the 3rd did not last long enough to do much towards the filling of Mutuswamy's tank, and all the water which lies on its mud bottom would be but a poor resource if Mr. Twynam's wells were absent. Before the wells were made, there were two tanks, one for drinking and cooking water and the other for ablutions. A large proportion of the natives finish off their bathing by an anointing of their heads and sometimes their bodies with oil. The effect on the waters of the bathing tank was such that a French Roman Catholic priest, who on one occasion visited the Fishery, said to Mr. Twynam: "I do admire your two tanks, one for bathing and one for drinking, but de vater of de bathing tank be all oil! be all oil!" It is an absolute fact that the results of the depilatory process to which natives periodically submit their heads has to be specially dealt with in the course of the scavenging operations which are constantly going on. The coolies, who are ever at work seeing that no dirt remains in the wrong place, wage such an incessant warfare against every plant that rises any distance above the ground, that to get any idea of the flora of this place I have had to go quite a distance beyond the smooth sward into which all the open spaces are being converted. The ravines cut by monsoon rains have been largely filled up and levelled, and the process is still going on. The heaps of shells from past fisheries are being utilized for this purpose, as no profit could be obtained from removing them to a distance for burning into lime or exporting them to Europe as a material for "mother-o'-pearl." The iridescence of the Ceylon pearl-yielding oyster is very beautiful, but the smallness of the shell detracts from its commercial value.

As fisheries took place at Kondatchi Bay and Arippu, there are heaps of oyster-shells at both those places, but those here at Silavatturai (which is now found to be the most central and convenient centre for fisheries) have been so extensively buried, that the visitor is at first scarcely aware that the nice sward he walks over is but the surface-covering of millions of millions of pearly-surfaced shells. In digging foundations for buildings or cutting lines for the enclosures in which the oysters are placed to putrefy and be examined, the nature of the subsoils is at once shown. Indeed, the surface over large areas glistens with fragments of shells. I may add that the shells, when bleached by exposure to sun and rain, assume the beautifully white, lustrous colour which is always associated with the "oriental pearl," as contradistinguished from the somewhat pinky hued gems of the Red Sea and Persian Gulf. The lustre of the freshly-opened shells, on the other hand, as I see them in my walks is of a rich bluish purple. I must correct a mistake I made in supposing that on the 3½ year old shells now being fished, there were large growths of coral and sponge. I was misled by some beautiful specimens of combined shell and coral, which turn out to have been fished from the Cheval-par and were quite mature (seven years old) when taken up. Not only are the oysters now being fished too young to have any appreciable growth of coral on them, but it is one of the

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singular circumstances connected with the pearl banks and the oysters, which are known as facts, but cannot be yet satisfactorily explained, that while oysters from the comparatively small Modaragam-par have seldom any appreciable growths of coral or sponge on them, those from the much more extended Cheval-par are largely coated with those foreign growths. It is surely a curious circumstance that while the pearl mussel cannot really flourish except when anchored by its byssus to a fragment of coral, the shell so situated should be made the base for very considerable coverings and erections of coral. Some shells are so built up with coral as to have only a very small orifice left through which to receive food, while yesterday I saw one entirely built into a mass of coral. The masses of soft red matter on the shells now being fished I have ascertained to be algæ. They abound and are vari-coloured, but a very beautiful pink-coloured species seems to predominate. It fades after a time of course, and the heaps of oysters in the "kotoos" look very much like large potatoes or yams covered with black earth. In passing those heaps it gives one "a turn" to notice the movements of the unhappy bivalves, which are literally "fishes out or water." A number of oysters with mouths agape, will suddenly bring the separated valves together and slide down, as if conscious (which undoubtedly they somehow are) of a presence with which they associate danger. I was not surprised to find that Mr. Twynam's observations in this direction had sometimes given him uncomfortable feelings with reference to the possible amount of pain felt by these creatures however low in the scale of being they are. But the pearl oysters are not swallowed alive as are their edible congeners: indeed the being good to eat in any shape is not amongst the merits of the pearl mussel. And as to pain, people now-a-days trust more to what science has discovered than what Shakspeare imagined when he wrote:—

> The poor beetle that we tread upon
> In mortal sufferance feels a pang as great
> As when a giant dies.

Not so, for the lower vitality is, the less feeling exists, and we have before quoted the case of the dragon-fly which ate a considerable portion of its own body when its tail was turned to its mouth, without apparently being aware of what was happening. In any case the sufferings of the pearl oyster are not greatly extended. Most are dead on the second day after being taken out of the water, I should say, and during this period I ought in fairness to state that the odour of the oyster heaps, breathes pleasantly of the sea and of healthy iodine. Although the word "kotoo" is retained, the enclosures now in use are simply pallisades. The fences would remind one of an elephant kraal, but for the slighter saplings used and the absence of supports sloping outwards. The Government "kotoo" is a large oblong square of doubled pallisades, a space for police guard-houses and the movements of the men being between the two rows. The oysters when lodged in the interior are carefully locked up and watched as their value justifies. As soon as the divers' shares are removed, the sale takes place, there being no limit to the number a man who makes a satisfactory bid, can have. The sale over and the money paid, orders are issued, and before the evening of next day, the Government "kotoo" ought to be clear and ready for a new supply. The sticks for the enclosures having to be brought ten miles, are expensive, and I could not help feeling that the non-existence of bamboos near at hand is a misfortune. Mr. Twynam has suggested wire netting for the enclosures, not only for the sides but to cover in the top, so that crows could not so frequently, as they now do, carry away oysters, perhaps some from which great things in the way of pearls were expected. Wherever an opportunity of mischievous theft presents itself, there the crows are sure to be, I saw *one* of them today bully and drive away a big hawk. The offence of the hawk seemed to be that he sat on one of a series of pillars which are as conspicuous, close at hand here as one of the trigonometrical towers is at some distance off. The tall pillars of brick and mortar, many of

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which are tumbling into ruins, were built to receive iron roofs, but Government seem to have objected to the expense of the roofs which alone would make the pillars useful, as the Home Government have done in the case of the Haputale railway. The capriciousness of the oysters and the consequent uncertainty of fisheries are no doubt arguments against expensive and substantial buildings; but the bricks ought certainly to be utilized for a series of modest buildings, instead of almost everything having to be done when a fishery is certain. The rush this time has been great owing to the sudden cessations of strong South-West monsoon winds and the dying of the oysters.

As to attaining anything like certainty or steadiness, or being able artificially to propagate the oysters, we seem as much in the dark as ever. On board the guardship yesterday (whence I saw another exciting scene of 114 boats crowding round the ship to announce their loads and to skim shorewards, the noise and confusion being wonderful) I had the advantage of going over the charts of the pearl banks with Mr. Twynam and Capt. Donnan, who readily answered all my questions. The general results were that an extensive area of bank, with from 6 to 8 fathoms of water on it, extends from near Mannar to Chilaw. The apparent conditions of bottom coral existing nearly everywhere, seems to be generally very similar: spat and young oysters appear periodically on all. But it is only on the limited spaces called the Modaragam and Cheval-pars that really good fisheries are ever realized; and even in regard to them, too often when all is most promising, millions and millions of oysters will suddenly disappear. If it can be any comfort to us our Indian neighbours have been much more unfortunate, a minute parasitic shell killing off holocausts of the oysters. And this reminds me of the theory which Capt. Phipps originated, which Mr. Thomas of the Madras Civil Service (the great Fisherman) took up and which the naturalists of the British Museum supported, that what had hitherto from all time been known as the spat of the pearl oyster is the spat of quite a different shell! All that Mr. Twynam, Capt. Donnam and other experienced persons, natives as well as Europeans can say is, "Then we should like to see the real spat of the pearl oyster. Destructive criticism is ingenious, but where is the substitute?" The disputed spat has always preceded oysters on the banks. Messrs. Twynam and Donnan have seen the spat changing into oysters on long tall sea-weeds, and as those long weeds have died down, the spat has gone down, adhered to the coral and become growing oysters. If experience is to be set aside, a more than Darwinian evolution must be substituted, and at present the opinion in Ceylon is that all the old authorities were right and that Capt. Phipps, Mr. Thomas, and even a British Museum naturalist are mistaken. Shellfish which grow in millions of millions must have spat in proportion and in that case it must be apparent. But where is it apart from the old spat? The forest flora of this place is of the usual poor description in droughty places. Mimosas and other thorny bushes, including spinifex, euphorbias and the pretty and useful yellow-blossomed cassia, the twigs of which are so largely used for green manuring in Jaffna. The ubiquitous suriya exists to some extent amongst the planted trees, but a few teaks and casuarianas do not look happy. Mr. Twynam is, however, gradually extending a grove of coconut palms on the sea-shore. They give agreeable shade for huts. Inland I notice the round heads of palmyras, and there is a patch of tobacco and some good moringa trees near the Custom House. Amongst the animal products of the district are good-looking sheep and donkeys. Silavatturai is in the district of Mannar, to what the population-bearing capacity of this arid district is, I find in the figures on a map before me:—Mannar 480½ square miles, 20,215 population; against Jaffna 185 miles and 244,994. The population of the Mannar district will be doubled before this fishery is over, but the increase will be no more permanent than the fishing.

Silavatturai, April 6th, 1887.

I went out this morning to have one "last fond look" at the private

"kotoos" where pearl oysters are going through a process of decomposition and putrefaction, which to a man of sensitive olfactories, justifies the making of "odorous comparisons." Oh! my talking of "eating the air." In the neighbourhood of "kotoos" I felt strongly through all my digestive functions that I was indeed feeding upon particles of the dear deceased—oysters. The first regular washing is to take place at noon today, for, as can be easily imagined, the more advanced the softening process of decomposition and the more the maggots of the blue-bottle flies have assimilated of the, to them, savoury morsels, the easier it is to feel and abstract the few and far between pearls from the tissues, especially near the hinge of the valves. It would be interesting to know and telegraph the results of the first search for gems on a large scale at this fishery, but I confess I am rejoiced not to be compelled to witness the revolting process of minute search through masses of matter and millions of maggots, while I have made arrangements which will secure to you daily intelligence of events connected with the pearl fishery. Mr. Twynam is of opinion that the fewness of the oysters yesterday was in no way due to the squall, which only caught the boats coming in, but to the fact that portions of the Modaragam-par, the bank which is being fished, are being exhausted. Be it remembered that Capt. Donnan's estimate for this bank was only seven millions of shells of which five millions have been collected in four days. But the bank will be fished as long as it is found profitable for Government and the boatmen and divers to persevere. Then "Tomorrow to fresh fields* and pastures new," if that is the correct quotation from Milton, which I believe it is *not*. What the portion to be now fished of the Cheval-par will yield, depends on the weather, and Capt. Donnan has arranged for postponing the little monsoon, just as Dean Swift postponed the eclipse, to the tune of "God save the King and his reverence the Dean." It is quite certain that Capt. Donnan is as well able to control the atmospherical elements, as the so-called shark-charmers were able to control those savage fishes. The occasion which enabled Mr. Twynam to abolish the institution of shark-charmer was that of finding the then functionary bidding ten miles inland for a paddy-rent while a fishery was in full process. When asked why he was away from his post, the impostor said that he had uttered his incantations from the beach and that their power remained potent. By a curious coincidence, however, at the very first fishery after the services of the charmer had been dispensed with, a diver was killed by a shark! Nevertheless the people have very philosophically and wisely recognized the puffings and groanings and blowings of the steam launch as quite equivalent to the old incantations. This and the case of the Kataragama pilgrimages shew what nonsense is sometimes talked about the danger of interfering with native customs and prejudices. The late Capt. Steuart attempted on religious grounds to get rid of the shark-charmer, but prejudice then, European as well as native, was too strong for him. One day Steuart said chaffingly to the snake-charmer: "If you can keep away sharks, of course you can bring them at your bidding?" The man assented, and by another most curious coincidence a shark appeared next day by the side of the guardship. Steuart forgetting his taunt turned on the shark-charmer and accused him of not performing the duty for which he was so well paid. The man triumphantly reminded him of his own words and pointed to the shark as proof that he (the charmer) could call something more substantial than "spirits from the vasty deep." Another institution which has disappeared is the firing of guns at the departure of fleets from the shore and again from the banks. The storage of powder was dangerous, and it has been found better to leave the hours of departure from the shore and return from the banks to the people themselves. Their interests and those of Government are identical, and it is pleasant to notice how considerately the Government Agent deals with the poor people who work so hard. For instance, chank fishing is not permitted on the pearl banks, but as the divers, on the sea-floor at 7 fathoms and gathering

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* "Woods" in place of "fields" was Milton's word.—COMPILERS.

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against time, cannot always nicely discriminate, numbers of other shells and foreign substances are brought up with the pearl oysters. Amongst the shells are pinnæ (the sharp points of which occasionally severely hurt the feet of the divers), cowries and a good many chanks. These latter are of market value, and as they are not plentiful enough to induce the divers to neglect the pearl oysters, the divers are kindly allowed to sell what they bring up. No royalty is charged and all attempts of the traders present to secure a monopoly have been resisted. At this fishery, as at all others, the hands of the divers are considerably cut in the course of their shell collecting at the bottom of the sea. The contingent of traders received yesterday by a brig from Colombo an accession of Parsee buyers, but neither they nor a grand swell of a "Sett" (another form of Chetty, of course) from Bombay have personally put in an appearance at the sales. They doubtless act through deputies. The "Sett," indeed, asserts he could not allow the *hoi polloi* come between the wind and his "nobility." The great Madras merchant who has purchased fully three-quarters of a million of shells, has been the subject of some boycotting by rivals, but for all such contingencies, including that of a strike of coolies yesterday, when the ringleader declared they would not work, even if the Queen followed up the command of the Government Agent! Feeling that this was distinct high treason, I requested Mr. Twynam to gratify me by adding the sensation of a military execution to the other exciting incidents of the fishery. There, in readiness, fully armed were the semi-military police, whose bugle call awakens us all at 5 a. m.; whose words of command at drill, we hear at intervals during the day, while the sentries give Mr. Twynam a Field Officer's honors, merely carrying arms to others. This was the only reasonable request which Mr. Twynam refused me, and on the whole, I suppose, he acted as properly as did my old friend, District Judge Toussaint of Point Pedro, when he declined to obey Sir Edward Barnes' order to give a man 30 lashes, without trial. I was struck with the beautiful smoothness and solidity of the beach here, as I walked along it this morning. No doubt this is due to the large amount of alluvial soil brought down by the Modaragam and other rivers. The firmness of the beach greatly facilitates the operation of landing the oysters from the boats which run right on the shore. There is quite a change in the weather, the sky clouded, the breeze cool, lightning flashing incessantly at night and thunder rumbling. There will probably be occasional squalls, but there are no tokens of weather which will stop what I hope may fulfil its early promise by turning out a most productive fishery. One thing is certain, that Mr. Twynam and Captain Donnan will do all that men can do to deserve success. Before leaving the scene of the pearl fishery, I cannot fail to express the gratification Mr. Siedle gave us all last evening by his performances on the cornet-à-piston. Classical music at a pearl fishery is enough to make the fishes join in the chorus. I must also do Mr. Twynam and Captain Donnan justice about the weekly day of rest, which both so highly value that only special necessity would have led them to interfere with its observance. Capt. Donnan incurred the displeasure of Mr. Birch when Lieutenant-Governor by stopping the fishery on Sunday, and Capt. Twynam told me that after a long spell of continuous fishery, the people came to him and said, "We cannot go on unless we are allowed Sunday rest."

I met here, after 41 years, Maartensz who drew entries at the Customs in my time and is now Sub-Collector of Point Pedro on my old salary of R120 a month. It was affecting to meet him, and to hear the Madras merchant say to me "You are an aged man, sir, and your good word will bring good fortune."

Quinton's Bungalow, Arippu: 1½ p.m.

Here I am *en route* for ancient and modern civilization in the shape of tanks and railways, leaving the scene of the pearl fishery regretfully behind me, as may well be the case considering the cordial courtesy and princely hospitality I have received while there. I recollect Quinton well, "a rough

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and boisterous captain of the sea." The bungalow is, as I said, on the site of an old Dutch post, which poor Knox first reached in his flight. Traces of the ruins remain and more than traces remain of "the Doric" which I passed *en route* and got down to inspect. As may be imagined I felt somewhat of a solemn sensation in revisiting in its decay a scene at which I had previously been present forty-three years ago, *en route* from Jaffna to Colombo. The Doric was then in such a condition as to be available as a resthouse for travellers, and here, with a companion, I slept or attempted to sleep, for soon after I had lain down I was awakened by a sharp bite in the head. Of course visions of a deadly snake and of inevitable and sudden death were vivid, but a search with a light revealed a—cockroach! If anyone despises the biting powers of the disgusting insect, let them only go through my experience of June 1844. As I walked round the Doric, and recalled the past history of the site and the building, my mind was carried back to visions of men of the Madura solar race, of the stately "Portingals," their brave if unscrupulous successors the Dutch, and in British times the courteous North, the bluff "King Tom," the gallant and dashing Barnes, and a succession of such men as Steuart and Dyke up to the era of enlightened sanitation and good management under the régime of Mr. Twynam. I cannot help seeing the ghosts of classical Greeks, of toga-clad Romans, of enterprising Arabs, of Indians and successive European conquerors, as I look over the now desolate shores of Arippu and see the native diggings in the soil for the shells of ancient times to burn into lime. If the ancients enjoyed there "feasts of shells" (see Ossian) it is a new experience here to me, as the guest of Mr. Boake to have breakfasted today on dugong flesh. The popular Tamil name for this clean vegetable feeder, whose habit of standing up in the water and looking about him, has given rise to the fable of the mermaid, is the "sea pig" but "Oh! no, we never mention it" in the ears of Muhammadans who are specially fond of the flesh, as well they may be, for had I not known what I was eating, I should have pronounced it excellent beef, with the fat somewhat gristly. This latter peculiarity the servant attributed to the age of the animal. Young dugong would no doubt be still nicer. Off the coasts of Northern Queensland, enormous numbers of these warm-blooded sea animals of a larger size than those of Ceylon, are captured for the sake of the large quantities of oil they yield. It was quite a surprise to me to find three specimens of the Madagascar tree, *poinciana regia* (the flambeau tree) in full blossom here and a mahogany tree flourishing, its group of coconuts look green and fresh but fruit is not superabundant.

I must acknowledge a most interesting communication which has reached me from Capt. Donnan. It is to the following effect, the date being the 13th :—

"We are now working on the Cheval, having left the Motarakam* on Saturday last, and if the weather keeps fine, of which there is every appearance at present, we shall do much better in the way of revenue than I expected when I recommended the fishery. I have been ashore only once since you left. You will remember that 'Arab' diver with the nose nipper. Well, I had him alongside this morning and told him to let me see how long he could remain under water and I carefully timed him, one minute and 49 seconds, which is the longest dive on record on these banks or beds. The other 'Arab,' with air-pump and dress, only worked one day with it, when he only sent up 1,500 oysters, and now, without the dress, he is sending up from 2,500 to 3,000 oysters per day; so that the helmet, dress, and air pump are not calculated to succeed at pearl-diving. I found also in 1884, off Chilaw, with four of Mr. Kyle's divers, that the natives sent up more oysters per day, man for man, than they did; a result which very much surprised me at the time, and now it has been confirmed again."

It will be observed that the so-called "Arab" diver, really a Hindu, from the Bombay Presidency, remained under water for a period extending to 109

* Popularly Moderagam.

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seconds, or, within 11 seconds of two minutes. What that means, only those know who have watched for the re-appearance of a human being who has remained half the time under water. It really seems "an age" to those who "watch and wait." Not only is 1½ minute the longest dive on record in the annals of the Ceylon banks, but I suspect that if sceptical criticism were brought to bear on the stories which allege subaqueous existence by divers for periods up to six minutes, this latest feat would be found to take rank amongst the most remarkable in the annals of diving where the diver has not been artificially supplied with air. No doubt the organs of the human body are capable of being educated, by continued practice to endurance of abnormal conditions and of adaptation to such conditions; to those of extreme heat for instance, if gradually applied. I could, therefore, understand a man who commenced a diver's life "sound in wind and limb," obtaining gradually the power of remaining under water and repressing inspiration and respiration for two minutes, or at the very utmost two and a half. But those who know that the blood is the life, and that it must, as it circulates be aerated, or lungs and heart will cease to act, will be slow to believe in a staying power under water of three minutes; far less of six. If such dives have ever been really made, *the record being accurately kept*, the conclusion must be that in such cases the respiratory organs were in an abnormal condition, or that some means of obtaining fresh air were adopted. It is not obvious how the use of a nose-compressor (made of horn, I believe,) could have aided the man who made the long dive. The other "Arab" alluded to by Capt. Donnan had an imperfect diving dress which, it will be observed, was rather an encumbrance than a help to him as a regular diver, in which capacity he was only thoroughly successful when he abandoned the adventitious aid. Much service to the pearl fisheries of Ceylon was naturally expected from the class of European divers who, by means of external air supplied to them, can remain not minutes but hours under water. But the hopes entertained have not been realized. For the ordinary operations of rapidly collecting and bringing shells to the surface, a regular diving dress is as much of an impediment as was Saul's armour to the shepherd lad who slew the giant with the simple weapons of a pebble from the brook projected by a sling. For exploring the banks and reporting on their condition, more might have reasonably been expected. But a thickly mailed and heavy booted European diver, with 7 to 9 fathoms of water pressing on him, is no light entity to walk over and inevitably crush the colonies of molluscs. Sir Henry Ward, in his graphic account of his visit to one of the series of pearl fisheries in his time, did not fail to notice the heavy and awkward movements of the regular diver under water, as contrasted with the lithe and rapid action of the next to nude native professional. As a matter of fact, Capt. Donnan, by the aid of a few well-trained and experienced native divers, who not only bring up specimens of the shells, but report on the conditions they have observed below, (for the divers keep their eyes open,—very wide open,) is better able to judge of the state and prospects of a bank, than he could be by any aid rendered by men in cumbersome diving dresses. Most useful are such men in exploring wrecks and in carefully and patiently building up submarine structures, such as our grand Colombo breawater. But there are limits to their functions, and those limits are reached when it is attempted to employ them in connection with pearl banks or pearl fisheries. In calm clear weather, I believe the bottom is distinctly visible through seven fathoms of water, (the *average* on the pearl banks,) and with a good glass to aid the eye, so, also, I should think, are most details of coral and algæ, living and dead shells, and even the movements occasionally of such fishes as skates and "old women," destructive enough, in all conscience, but not to be compared I suspect to the deadly operations of the voracious whelks, who only want a small chip on the edge of a shell, or the incautiously prolonged opening of the lips of its prey to make short work of the animal, whose nacre-secreting powers has made it so famous

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and so valuable. For scientific observation, however (observation which may lead to important economic results), I should think the electric light might be employed with advantage. There is very much in "the life history" of the pearl mussel (*Avicula* [*Meleagrina*] *margaritifera* of LINNÆUS), which is obscure or utterly unknown. We know that on banks with the proper conditions of depth of water and other circumstances, but the bottom of which is merely sand, the bivalves will not settle, because the ground presents no solid object to which the creature can anchor itself by its byssus, or beard, an organ which it has the power, often resorted to, of throwing off and renewing. A sandy bottom strewed profusely with coral or other rocky fragments, capable of offering a steady resting-place to the aggregated mollusks, presents the necessary conditions, with, always, about seven fathoms of water over the bank. So essential is this latter condition that if ever the hitherto abortive experiment of breeding pearl oysters artificially is to succeed, it must be secured. Shallow estuaries, the water of which has a warm temperature such as the edible oyster rejoices in, would, we now know be fatal to "the pearl oyster." But all the conditions of a coral-strewed bottom in seven fathoms of water may be present, as they are in many places between Arippu and Chilaw, and yet the pearl shells will either never settle on them, or never settle long enough or in sufficient numbers to render a fishery of such banks profitable. Even on the two banks on which the oysters do settle and sometimes remain until they more or less attain maturity (the full term of life being seven years, but their fishing age ranging from 2½ to 4 years), the effects of currents by which the masses of spat are driven hither and thither, and the other conditions which lead the spat to settle, and fix themselves and grow for a longer or shorter period,—sometimes the whole millions vanishing as suddenly and mysteriously as they came,—are all wrapped in much obscurity and require patient investigation.

Of one thing my recent visit and observations have convinced me, that amongst the main reasons why, in the midst of all their capriciousness and precarious, the Modregam bank just fished and the Chevalpar now having so successfully dealt with are such favourite resorts of the pearl oysters, is *the large quantity of fresh water*, with all that it contains of vegetable and animal matter suitable as food for the animals, which several large rivers pour into the bay of Silavatturai. The fresh water, of course floats for a long period over the salt, and Mr. Twynam told me he has dipped perfectly fresh water from the surface many miles from the shore. No doubt, in periods of extreme flood, the rivers may do harm instead of good to the oysters on the banks, by bringing down such enormous quantities of alluvial matter, that the bivalves are smothered in the resulting mud. This effect, when it has occurred has been easily seen and duly recorded, but I cannot at this moment recollect if due prominence has been given to the theory I venture to advance, or support, if it has been advanced, that under ordinary circumstances the rivers which embouch into the bay opposite the Modregam and Cheval Pars, which are only about twelve miles from the shore, must have an important influence for good: probably in modifying the temperature and quality of the sea water with which the fresh gradually amalgamates, but especially in the quantity of vegetable and animal matter, (land plants, leaves, and flowers, fresh water algæ, earth worms, insects of various kinds &c.,) they bring down and which, first their own momentum and then the currents carry over the bank and deposit amongst the oysters. Such is the strong belief forced on me, and I also feel that the Pearl Banks of Silavaturai, the "buried city" of Anuradhapura, and the Great Kalawewa lake, are connected together by a chain of most interesting physical circumstances, to which further reference may be made. Meantime, let us congratulate Mr. Twynam and Capt. Donnan as well as the Governor and all the inhabitants of the Colony on the gratiying success of the JUBILEE YEAR PEARL FISHERY.

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Having got hold of the idea that I was dealing with 100, and comparing the relation of 49 to that round number, I fell into an unfortunate mistake yesterday, by which the performance of the "Arab" diver, timed by Capt. Donnan, was greatly depreciated. As readers will have seen for themselves, one minute and forty-nine seconds, is not merely an approach to one minute-and-a-half, but closely verges on *two minutes*, being only eleven seconds short of that period. The stay under water was twenty-seven seconds in advance of Sir Henry Ward's timing, twenty-six beyond our own, and sixteen in excess of the longest dive ever observed by Mr. Twynam. I have Captain Donnan's authority for saying that the period under water now observed by him, is the longest on record in the annals of the Ceylon Pearl Fishery. Captain James Steuart, so long the Inspector of the Pearl Banks and who collected so much information regarding them, never knew a diver to remain at the bottom longer than eighty-seven seconds, or to attain a great depth than thirteen fathoms; while on ordinary occasions they seldom exceeded fifty-five seconds in nine fathoms of water. It is very true that Le Beck *says* that in 1797 he saw "a Caffre (?) boy from Karical, remain down for the space of seven minutes," but we have no details as to the chronometer used or the precautions to secure accuracy otherwise taken. Although, therefore, seven is a perfect number, we take leave to doubt it. We may be prepared to admit that a human being may hold his breath and retain life under water for two minutes, or, at the very utmost three. But allegations that twice the latter period or more of non-inspiration and non-aeration of the blood has been endured, seem incredible. In the absence of a good time-measurer and careful and conscientious observers to watch its movements and the diver's re-appearance, even two minutes under water might easily be exaggerated into six, so long does the interval between disappearance and re-appearance seem to the spectator. Six minutes is the period mentioned in the *Encyclopædia Britannica*, latest edition, but as no authority is given I must remain sceptical. In the same article it is stated that, as the result of their trying vocation, the divers are short-lived. Here, also, I prefer the testimony of such largely-experienced and careful observers as Mr. Twynam and Capt. Donnan. The men, generally, make good earnings, live well, being nearly all meat-eaters, look well and have as good chances of prolonged life as those who follow less hazardous occupations. One reason, no doubt, is that instead of any attempt to remain under water for prolonged periods, their average stay below is somewhat under rather than over one minute. With prolonged intervals to recover breath, to rest and to sun themselves by the sides of the boats (working as they do by relays), their labour hours, as far as diving is concerned, extend only to the seven or six-and-a-half hours from daylight to 1 p.m.

The problem of how to obtain a sufficiency of properly trained divers, if the sea-harvest prospects of Ceylon and India for the next two years are to be realized, is a most serious one. I have already indicated that, what with the fishery now proceeding; a second to be undertaken in November of this year and a third in March-April of next year, Capt. Donnan estimates the removal from the Ceylon banks of not far from two hundred and fifty millions of oysters in twelve months. Large as this number is, it sinks into insignificance, when compared to the Indian estimate of *nine hundred millions* on the banks off Tuticorin. That was the estimate about a year ago, and from the account given in the article we quote from the *Madras Mail*, of the oysters lying over a foot deep on the banks, (the habit of this mollusk being to cling not merely to foreign substances but to each other in large aggregations) we suppose no adverse influences of currents or *suran* have yet operated to add one more to the many disappointments endured by our Indian neighbours. The Ceylon banks, no doubt, owe much of their success to their specially sheltered position, the long, alligator-like island of Karaittivu contributing considerably to this result. In the comparative quiet, the fresh water brought down by the rivers mixes with the salt water. We submit as a question for

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examination whether the large admixture of fresh water with the sea over the Ceylon banks, may not have *something* to do with the exemption of our pearl oysters from the destruction which a minute, parasitical shell has so frequently inflicted on those on the Indian banks. When formerly writing on the subject I compared the mode of growth of the pest in question to that of the red spider on the leaves of plants. The leaves in the one case and the animals in the other are suffocated by the films of the parasite. The *suran* is so little known on the Ceylon Banks that Sir Emerson Tennent did not even allude to it, and we are not aware of any reference to its existence in any reports on our local fisheries. But in regard to the Indian fisheries, its relation to the oysters is almost that which *Hemileia vastatrix* bears to coffee. If, however, Capt. Phipps is correct in the statement that if the young oysters can only get a year's start free of their enemy, they are safe, it would seem that danger from this source is at an end as regards the five squar miles oysters described by the *Madras Mail* as being ready for fishing next year. The Hon. H. S. Thomas, of the Madras Civil Service, in his elaborate Report of 1884 on the Pearl and Chank Fisheries of India and Ceylon, states that the *Suran* (mis-spelt *suram*, *sooram* and *thooram*) is a *Madiola*, a name derived from its resemblance to a small measure or drinking vessel. There are 70 existing and 150 fossil species of this genus *Mytilidæ*. And then he quotes:—"The *Madiolæ* are distinguished from the mussels by their habit of burrowing or spinning a nest, using stones, fragments of shells and the byssal threads" (Tryon's Conchology) "and this," he adds, "is the peculiarity with which we are practically concerned. Making by aggulination, a regular blanket of triturated shells and sand, they seem to cover and smother the oyster with it. If they are found mixed with young oysters, less than one year old, the destruction of the whole bed of oysters in this way is reported to be the invariable result." He goes on to state the opinon of the divers that the age of the *Madiolæ* being four years while the oysters attain, or would attain, seven years, the dead *Madiolæ* putrify and poison the beds. But this is not credited by Captain Phipps or Mr. Thomas, who, on the contrary, believe that after the oysters get beyond one year old, they are able to eat the spat of the *Madiolæ* as it falls. The *Madiolæ* are also preyed upon by a "trigger fish," *Balistes mites*.

The *Madras Mail* is greatly mistaken in supposing that chank fishing has been abandoned in Ceylon. The writer has probably been misled by the fact that fishing for chanks (*Turbinella rapa*) has been forbidden, and very properly so on the pearl banks. In the early part of this century, the chank fisheries of Ceylon were of very great importance, the shells being exported to India, in enormous quantities. And still the fishing of live chanks from the sea and of "dead chanks" from deposits of mud goes on to a much greater extent and value than the *Madras Mail* shews for the southern Presidency. Referring to *Ferguson's Directory* we find that in 1884, the chank fishery of the north of the island realized not R25,000, as in the Madras Presidency, but R174,762, thus:—From the mud in the shallow water of the channel between Jaffna and Elephant Pass, the shells dug out were 615,000 valued at R123,660. Of live shells fished the number is given at 1,179,000, valued at R51,102. But what with approaching great pearl fisheries in India and Ceylon the question is where are the divers to come from? In Ceylon the boatmen and divers now receive as their wages one-third of the oysters they bring on shore. But no inducement can create divers. Apart from the Persian Gulf and Red Sea, the Eastern Archipelago might yield help, in the severe competition which seems inevitable.

PEARL FISHERY OF 1887.

The Report of the Government Agent, Northern Province (Superintendent of the fishery), to the Hon. the Colonial Secretary, dated Silavatturai, May 16th, 1887, states:—

The banks fished were the Northern Motaragam, about two and a quarter

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miles in length and half a mile in breadth, and the North-East Cheval, about two miles in length and half a mile in breadth.

The oysters on these banks were only three and a half years old, and it was estimated that they would yield fine fisheries in 1888 and in 1889, by which time they would have reached maturity.

As the oysters were young, it was not considered necessary to inspect the banks in November last. During the inspection of March, however, it was found that the oysters on the Motaragam bank and on the southern part of the West Cheval were dying out, and should, if possible, be fished at once. Captain Donnan estimated the number on the Northern Motaragem at 7,000,000.

Arrangements were accordingly made for fishing these oysters in the usual way, although it was late in the season to give notice of and commence a fishery. Intimation was given by telegram on March 18th and 19th to the principal merchants and traders of South India, who generally come to the fisheries, and to the divers of Keelakarai and Tuticorin, that there would be a fishery.

Notwithstanding the sudden and unexpected notice of a fishery, a sufficient number of merchants, traders, boatmen, and divers had arrived in Silavatturai by April 1st to admit of operations being commenced; and the fishing of the Northern Motaragam was accordingly commenced on the morning of April 2nd with 91 boats and about 700 divers, the number increasing in a few days to 116 boats and about 1,000 divers. Fishing was carried on on this bank till April 9th.

The sample raised from this bank proved to be a very indifferent one, and did not, in my opinion, fairly represent the quality of the oysters on the bank. It was valued at only R104·15⅜ equal to R9·87 the 1,000.

From this (the Northern Motaragam) 8,434,330 oysters were fished, of which the Government share (5,622,887) sold for R103,664·83, at rates from R15 to R35 per 1,000.

The sample from the West Cheval turned out a very poor one indeed, and was only valued at R72·60, equal to R6·91 the 1,000.

The sample from the North-East Cheval was, however, a comparatively fine one, valued at R144·17½, equal to R11·14 the 1,000.

Taking into consideration the superiority of the sample, the large number of oysters on the bank, the eagerness with which the fishing of the bank was looked forward to by the large number of merchants and traders in Silavatturai, and the fact that the bank could be more easily fished than the West Cheval in the event of southerly winds setting in, as might be expected, so late as it was in the season, Captain Donnan and I deemed it advisable to fish the North-East instead of the West Cheval.

Fishing was commenced on it on April 11th and continued till the final stoppage of the fishing on May 7th.

The total number of oysters fished from it was 22,513,575, of which the Government share (15,009,050 oysters) realised R292,430·74 at R14½ to R35 per 1,000.

The total number of oysters fished from both banks was 30,947,905, of which the Government share (20,631,937) was sold for R396,095·57. Adding to this the proceeds sale of sample pearls of Motaragam and Cheval banks (R530·50), the total receipts on account of the fishery was R396,626·07. The expenses of the fishery will be about R50,000, leaving net proceeds R346,626·07.

The attendance of merchants and traders at the fishery was very much larger than it was expected it would be. Many of the leading merchants and traders of Madras and Negapatam arrived in Silavatturai before fishing commenced, and in a few days there were as many from all parts of Southern India as I have seen at any previous fishery. In addition to those who have generally come, there were on this occasion some pearl merchants from Bombay—Muhammedans, Banyans, Brahmins, and Jains—who had never been at a Ceylon fishery before, many of whom had come to buy pearls and not oysters. One

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of them informed me that he had never come to a fishery before, because he had never heard or seen notice of one.

I have annexed to the diary a list of the principal merchants who have attended the fishery,* and would beg to suggest that notices of any future fishery be sent to those of Bombay and Madras through the Agents of the Colony in Bombay and Madras.

Almost all the divers came from Keelakarai and Tuticorin: the greater number were as usual, Muhammedans from Keelakarai. These men said that they had caulked up their boats at night, and got them ready as best they could immediately on receiving notice of a fishery, some of them came over and worked in large Paumben boats built upon the European model, instead of in the ordinary native boats. They all worked well to the last.

The Paumben boats worked very well, having been able to beat in and out against an unfovourable wind much better than the native boats. They are much larger, safer, and more comfortable for the divers when going out and coming in, and when waiting on the bank during the night than the native boats, and their use should, in my opinion, be encouraged. I believe there was at one time a prejudice against them, owing, it was said, to the difficulty experienced in paddling them when the wind failed. The divers and manducks managed, however, to make them go well through the water on this occasion.

Many of the Tuticorin divers came over in large "Tuticorin cotton cargo boats," which, like the Paumben boats, worked well. These divers rendered very efficient service, having worked quite as well as the Muhammedan divers. They left this with their boats when the unfavourable weather set in at the end of April.

There were at this fishery two Arab divers—one from the Persian Gulf, who had heen working in Tuticorin for two years. This man used a horn nose-clip, the first I have seen used by any diver on the Ceylon banks. He went down alongside the inspection vessel, and was carefully timed by Captain Donnan; he was under water one minute and forty-nine seconds. This man worked very well, raising 3,000 oysters sometimes in a day.

The other Arab had an air-pump and dress, with which he tried to work one day in a boat by himself with his attendants; he raised, however, only 1,500 oysters, whilst the ordinary divers were raising from 1,500 to 3,000; so he abandoned the dress and worked during the remainder of the fishery as an ordinary diver, finding it more profitable to do so.

To the merchants and traders the results of the fishery have, I believe from what I can gather, been tolerably satisfactory, though some complain of loss.

The Bombay merchants, who came merely to purchase pearls, expressed themselves, somewhat disappointed, owing the high prices at which pearls were selling, the prices having doubled as the fishery progressed. One Bombay trader said that he could get pearls cheaper in Bombay than at the fishery; that the demand for pearls in Bombay was for the European market; that the best pearls were selected for the European market, and the rest sold in India. It was also said that there was a demand for pearls just now in China.

Most of the merchants and traders who purchased and washed oysters have, I believe, from what I have heard, turned in their money with some profit, but not so much as they hoped for and looked for. It is stated that the Northern Mótaragam oysters and the oysters of the first two days' fishing of the North-East Cheval Paar paid them well, but that they all lost something on the oysters of the subsequent fishing from the Cheval.

There is no doubt that if the Motaragam oysters could have been left till next year they would have been very rich in pearl. The oysters of both the Motaragam and Cheval, it must be borne in mind, were only three and a half years old, and immature. The samples taken from them, though comparatively

* Not printed.

poor, were quite as good as could be fairly expected from oysters of that age. It is owing to the high prices at which pearls were selling after the fishery commenced, that the prices of oysters at the Government sales rose so much above the valuation of the samples.

At the close of the fishery the merchants said that the Motaragam oysters yielded more and finer pearls than the oysters of the Cheval.

A peculiarity in the pearls of this year was the very large number of slate-coloured and brown pearls, commonly called "black pearls," amongst them.

The divers, boatmen, and manducks have all done very well.

To the people of the Mannar district, and I may say to the people of the Northern Province, but more especially to the people of the Musalai Pattu of the Mannar district, the fishery, unexpected as it was, has been a perfect godsend.

It has afforded lucrative employment in many ways to a large number of cultivators whose crops have failed owing to the want of rain, to boat owners and petty traders, and to labourers from Jaffna and other places who have earned as much as a rupee a day at times for services rendered to the merchants in carrying and washing oysters. It has also afforded employment to a large number of women and children in sifting sand for pearls.

Had it not been for the fishery, it is very probable that Government would have been called on to provide relief works for the people of the Mannar district.

The arrangements at Silavatturai for the fishery were carried on under the Superintendence of Marisalpillai Seemampillai Mutaliyar, Adigar of Musalai, who deserves very great credit for the activity and zeal displayed by him in so pushing on the arrangements that no difficulty was experienced in commencing work on April 1st.

Silavatturai was healthy throughout the fishery, as may be seen from the report of Dr. Keyt annexed.*

Sanitary measures were strictly enforced, and there was at all times a liberal use of disinfectants. The burning of coal tar as a disinfectant was much appreciated by the people, and application was made by some of the merchants that coal tar might be burnt near the private kottoos, so that the smoke might roll over them.

The food supplies were abundant, the bazaars having been always well stocked with articles of diet suited to all classes at the fishery.

The water-supply was good and abundant. Although owing to the failure of rain there was, I may say, no water in the two tanks—Muttusamy and Donnan's tanks—at the commencement of the fishery, there was always a supply of good water from wells, twenty-seven in number, on the beach. Owing to the heavy squalls of rain which burst over the town in April, there was a fair supply of water in the tanks after the middle of April.

With the exception of a quarrel regarding the price of oysters between some Moormen of Mannar and Moorish divers of Keelakarai, which ended in a fight, there was no disturbance or breach of peace during the fishery, the people having been orderly and well-behaved. There was very little crime, and that only of a petty nature.

A post office was, as usual, opened at Silavatturai during the fishery, but it was not found possible to run up a telegraph line in time for this fishery, as was done in 1881; and a special night telegraph post was therefore established between Silavatturai and Mannar to suit the convenience of the merchants and traders.

The Mannar Kachcheri and Courts were, as usual, removed to Silavatturai during the fishery, and were in charge of the Assistant Agent Mr. Boake.

The medical staff consisted of Dr. Keyt, Colonial Surgeon of Jaffna, Mr. Strong, Medical Practitioner, and Mr. Moonyaiah, Health Officer.

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* Not printed.

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The Sanitation of the town was entrusted, as in 1880 and 1881, to Mr. Navaretnasinghe, Medical Practitioner, assisted by ten overseers and ninety scavengers. Dr. Keyt personally made health inspections of the town and divers' quarters twice daily, and saw that sanitary measures were properly carried out.

Officers for the several departments of the fishery were selected from all the departments in Jaffna and Mannar.

Mr. Tocke, Forester, acted as kottoo superintendent.

The police force on this occasion consisted of only five sergeants and thirty constables, all in charge of Sergeant Narayanasamy, No. 1,062 of the Jaffna police. The sergeants and constables have all behaved very well, and have rendered very good service. There has not been a single case of default.

The kotto establishment under Mr. Tocke had very hard work at times, owing to the large number of oysters brought in. On one occasion they were working for over forty-eight hours, with scarcely any intermission, much of the the time in heavy rain.

A reference to the diary will show the services rendered by the Inspection Department (of coxswains, boatmen, and engine driver and crew of the S. S. "Active"), which was more especially under the immediate orders of Captain Donnan.

All have worked harmoniously, zealously, and well; and to all I am much indebted for cordial co-operation and assistance throughout the fishery.—I am, &c.,

W. C. Twynam, Government Agent.

THE PEARL FISHERIES.

Address by Mr. A. M. Ferguson at the Conversazione of the Royal Asiatic Society, November 26, 1887.

(From the Ceylon Observer, November 28, 1887.)

Mr. Ferguson, after a few preliminary remarks, said:—However little interest there may be in what I may say, I am quite sure you will all be interested in this beautiful chart which Col. Clarke has had prepared at my request at the Surveyor-General's Office, and which like everything that proceeds from that office does credit to it. Looking to this portion of the Gulf of Mannar you will see at once the two great series of pearl banks. Here are the Ceylon ones extending from near the island of Mannar right away to Negombo. The really prolific and profitable banks the Cheval and Modaragam pars are coloured red. There are 19 banks on the Ceylon coast, and 66 on the Indian, 85 altogether, but a large number of them, nearly the whole of the Indian ones, might be blotted out as far as real profit is concerned, and all the Ceylon ones except the two mentioned. Most of the oysters fished and most of the money that has accrued therefrom to Government have come from those two banks. The draughtsman has not been able to show what is so very prominent in the Gulf of Mannar, and that is its series of currents. It is torn with successive strata of currents, some on the surface and some at various submarine depths, and if you want to know the real cause why pearl fisheries in Ceylon have so often failed, and why as a rule they have failed in India, you will find it in the currents which come sweeping round from the Bay of Bengal, up the Ceylon shore, and then rush with immense force against the Indian coast, carrying with them enormous masses of sand and mud to such an extent that we have ridges of some size on the Ceylon banks and others no less than twelve feet high on the Indian side. You have heard of many enemies of the pearl oyster. The "trigger fish" (a *balistes*) which is very irreverently called the "old-woman" fish in Ceylon, and you have heard of rays or skates with hammer-like teeth, of chanks and other shells, and even sea snakes have been charged with eating the pearl oysters, which is utterly impossible. The real and the great enemy of the pearl oyster however, is mud carried on fierce sweeping currents. We are very ignorant, and we have much to learn of the laws which guide the life history of the pearl oyster from the time that it swims rapidly in its larval stage until the stage when

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it becomes the mature oyster, yet we know that it depends upon certain circumstances of currents, the currents meeting and counteracting each other, and so producing conditions favourable for the deposit of the spat on the banks, and then the shells being allowed by the continuance of favourable conditions to attain the age of pearl bearing and of maturity. Altogether the pearl oyster is an exceedingly interesting animal. The word "oyster" although wrong scientifically, has yet been so long applied that we are perfectly safe in using it; for the creature is really so much like an oyster, though it belongs to the mussels from its possession of a byssus or beard by which it is able to anchor itself on masses of rock, and the conditions generally favourable for the pearl oyster are large pieces of coral and other rocks at the bottom of the sea at an average depth of seven fathoms. It is very interesting to see the instinct by which the oyster rises up as high as it can attain to and find support. It has a horror of a sandy bed. The pearl oyster, if it finds itself deposited on sand, has a foot with which it actually walks, and it makes as good a use of its one foot as many human beings do of their two. It has, in truth, very remarkable powers of locomotion, enabling it to go in search of a fitting abode, if it finds the conditions where it has been deposited unsuitable. After finding a suitable place of location it throws out beautiful silk-like filaments of great strength to form the byssus by which it anchors itself, and the foot is positively used as a hand to adjust the filaments and fix them on the rock to which the oyster desires to attach itself. The chief interest, of course, in connection with the pearl oyster, is its power of depositing nacre. Any foreign substance getting into the mantle of the animal producing irritation is at once by a beautiful instinct coated with this nacreous mucus. The first operation of the oyster is to provide itself with a comfortable and smooth abode. No lady ever paid more attention to the furnishing of her boudoir than the pearl oyster does in making an abode for itself and its interesting little family, which consists at one time of only 12,000,000 eggs! (Laughter.) No human being, of course, ever counted 12,000,000, but Dr. Kelaart computed that in an individual examined by him under the microscope there were 12,000,000 of eggs, and seeing that the creature begins breeding when one year old and continues the process during the larger portion of its full existence you can, or rather you cannot imagine the millions and billions of progeny that are produced and which float away on the sea and form food for multitudinous fishes. Of the millions upon millions of oysters that are produced in the young stages only the smallest possible percentage ultimately settles on the rocks, and of these again only a very limited percentage come to the pearl-bearing stage. In face of the great forces of nature that I have mentioned we are practically helpless, and all ideas of artificial culture are, of course, defeated. If we could place buoys in the sea, with great coir cables or mats floating in the water, and if we could possibly so anchor them that they would resist the force of the winds and currents, there is no question that the pearl oysters would fix themselves on such objects, and pearl fishing would then become a very different and more facile operation to what it now is. Besides directing your attention to this beautiful chart I would ask you to look at this graphic sketch which I have had prepared for me by Mr. J. L. K. Van Dort of a diving boat and the scene at the pearl fishery. In the background there is the guardship, one of those very fine schooners which the Ceylon Government provides for the bringing over of the immigrant coolies to whom Ceylon owes so much. With regard to the steam launch which figures in the animated scene I may say that that it is now the very effective representative of the old shark charmer. You have all read about the romance of the pearl fishery, and one of the chief and most interesting objects was a "charmer" who was employed to charm away the skarks so that they did not attack the divers. Mr. Twynam found that the last "shark charmer" instead of being at the pearl fishery was a score of miles inland bidding for paddy rents, so he finally dispensed with the services of the shark charmer. The gun which used to be fired as a signal for

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the boats going out to the banks and returning to the shore has also been dispensed with. The custom was expensive, and the storing of gunpowder was dangerous. The operations of the fishery proceed smoothly without the incantations of the snake charmer or the reports of the gun. The formation of the exterior portion of the pearl shell is curiously adapted to a useful purpose, so that it has been quaintly said of the pearl oyster that it carries its commissariat on its back. The construction of the exterior of the shell is such that the conditions are highly favourable for the growth of algæ, which are the home of organisms, animal and vegetable,—infusoria and diatoms. The diatoms, minute vegetable particles, excel even the oyster in reproductiveness, for they multiply at the rate of 500,000,000 per month,—that is all. (Laughter.) Pearl oysters produce their own food, which is drawn to the mouth of the creature by a current it has the power of creating, and it is a question not so much of age as of abundant provision of food that regulates the size the oyster shall attain, and what pearl-bearing qualities it may have. It is a very difficult question indeed to decide the age of oysters, and many mistakes have inevitably been made. The Ceylon pearl oysters, in consequence of the superior conditions in regard to shelter and food, are of a much larger size than the Indian ones. They are altogether superior. Whatever precariousness there may be about the fisheries of Ceylon they are much more profitable than the Indians ones, for the result for a series of years of fisheries shows that the pearl banks of Ceylon yield an average of R60,000 per annum to the revenue, while the Indian pearl fisheries yield only R5,000 per annum, or one-twelfth of the Ceylon contribution. Now, ladies and gentlemen, I can only just touch on the process of diving for shells, which is exceedingly interesting. The class of people who dive have been trained all their lives in chank fishing. They are all meat-eaters, either Mahomedans or Tamils. I saw not a single representative of the Sinhalese race at the Jubilee Pearl Fishery, and I do not suppose such a thing as a Sinhalese pearl diver exhists. It is a curious fact, but the divers are all, as I have said, Mahomedans or, so far as I know, Tamils, who are meat-eaters. They feed well, and they are consequently able to undergo great fatigue. I have seen it stated in books that the consequence of the lives they lead is that they are short-lived. Mr. Twynam and Captain Donnan are not of that opinion. You will have seen exaggerated statements in some publications about divers remaining under water four minutes and even six, I believe such a thing is impossible. In any case there must have been some abnormal conditions to enable any human being to abstain from breathing, and to endure the non-aeration of the blood for so long a period. In this last fishery Captain Donnan timed a diver to 109 seconds, the period in which the diver was under the water, and I should like to know if that has ever been exceeded. To see a human being go under water, and mark the time he stays there, though it is only less than a minute, it seems a perfect age. Now about the sharks. I think it is pretty certain that in the whole course of the Ceylon fisheries only two human beings have fallen victims to these fierce fishes. The people jumping into and rising out of the water and the sound of many voices with all the noises of depositing the oyster in the boats, form great protection. It is also a curious fact, but it is one which all of us know who have been any time resident here, that a dark skinned person has a great many more chances in his favour against attack from a shark than a white skinned person. The Arab divers of the Persian Gulf are so well aware of this that they artificially blacken their bodies when they dive fof pearls. There is another very curious thing about the divers and crews in the boats. Those of you who understand the science of numbers may be interested to know that they seem to have adopted the decimal system. There is no reason why they should not have three sets of divers on one side and three on the other of the boat, but there are actually three sets on one side and only two on the other —ten divers, ten boatmen, and three others, and I submit that it is quite probable that the decimal system has been adopted for the facility of counting

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and dividing. You all know that instead of one-quarter of the produce of the fishery it has recently been found necessary to allot to the divers, whose work is very hard indeed, one-third of the produce. It is a most interesting sight to see the fishing boats begin in the morning by dawn, and anything more beautiful and poetical you cannot imagine. Floating over a sea that previously was as silent as death, (the guard ship resembling "a painted ship upon a painted ocean,") you see them all rushing up, taking their stations, beginning the diving operations, and working away without intermission from dawn till half-past twelve or one o'clock. Then they come sweeping back again passing close to the guard ship were the superintendent of the fishery stands and shouts out "Ettana chippei?" (How many shells?) and they answer, some 5,000, some 7,000, or 10,000; others 15,000, and so on. The lower numbers elicit derisive groans, but if a man says 25,000 or 30,000 there are cheers. A diver has been known to collect 80 oysters at a haul, but 40 are nearer the average, and a couple of millions have been landed in a day. The boats make for the shore as fast as they can, each boat striving to be first, and the oysters are divided into lots, the divers are allowed to take their portion of one-third of the shells at once and sell them, and by selling them in small quantities they are often able to get better prices than the Government share realizes. The prices they get generally, however, regulate largely the prices that will obtain at the public auction. And a curious and weird sight is the public auction! Those I saw took place by lamp-light, Mr. Twynam sat at a table, and the buyers were ranged round. The latter seemed to have combined in some agreement amongst themselves as to the prices, but generally their cupidity would get the better of all promises and they began to bid one against the other going up to higher and higher prices, much human nature being evinced. In my time in Ceylon, oysters have been sold at from R8 to £18 per 1,000. £18 was was given for oysters in the time of Sir Henry Ward and I do not know of any higher figure.

Of the subjects noted for remark, we were compelled to omit many of the most interesting. We were not able, for instance, to refer to shells of the pearl oyster, chanks and corals which we had before us for illustration. There were shells, pure and simple, from the Jubilee Fishery, and by way of contrast others when fully mature oysters were taken from the Cheval Par. These latter were coated over by beautiful structures of coral of most varied design, and there can be no doubt that the coral insect, while in one respect the friend of the pearl shell, in providing blocks for the mollusks to affix themselves to, are amongst their enemies by loading them with elaborated carbonate of lime, so abundant in the waters of the Gulf of Mannar, and in some cases hermetically sealing up the shell and animal in a tomb of rock. For we saw specimens of shells so entombed at the scene of the late fishery. But we forgot our chief point, which, however, we urged on the Governor subsequently, and that was, that, out of the large revenues likely to accrue from the great fisheries now apparently certain, an aquarium should be provided in connection with the Museum, by means of which the people of Colombo and visitors would be enabled to follow all the stages in the life history of the pearl oyster. We *think* the Scotch Governor met the proposal in even a more liberal spirit than ever his Irish predecessor did the suggestion that Captain Donnan, who had laboured so hard to make pearl fisheries successful, ought to benefit by a share of the proceeds, Governor Gregory was equal to the occasion and generously conceded that Capt. Donnan was welcome to all the oysters he could dive for and bring up! Capt. Donnan's advocate is understood not to have gone into ecstacies of gratitude, for, though it is true that one oyster may contain 150 pearls, yet 150 shells may be opened and not one pearl found! We meant specially to point out that, if artificial culture of the pearl oyster became possible, the intrinsic value of true pearls (which the imitations closely approach in beauty) would be most seriously diminished. But the great and

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satisfactory fact to which we wish to draw attention is that provided a sufficien supply of boats and divers can be obtained there is an almost certainty of large and profitable fisheries on the Cheval and Modaragam Pars in 1888 and 1889, while Capt. Donnan is said to have discovered a fresh bank stocked with oysters estimated at 50 millions which will afford a fishery in 1890! In the face of all this what pity can there be for the poor pessimists who tell us that the colony cannot afford to recommence railway extension! As to the apparently fabulous powers of reproduction of the pearl oysters, we may say that exaggeration is impossible. Even deposited oysters, fairly grown have been found on the Indian banks, in successive strata superinposed to the height of a human being. This was in 1884 when the calculation was that there were five hundred thousands of millions, that is *half a million of millions* (!) of oysters on the Indian banks. How many millions remain for fishing we do not know, but we should think not fewer than a thousand millions; while we venture to anticipate Capt. Donnan's report by estimating the number available for fishing in Ceylon within the next three years at not less than 200 to 300 millions.

THE PEARL FISHERY, THE ANCIENT TANK REGION, AND THE RUINED CITIES OF CEYLON: AND HOW TO GET TO THEM.

(From the Ceylon Observer, November 29, 1887.)

When the railway to Jaffna is constructed, with a branch from Anuradhapura to Mannar, and another to Trincomalee, a visit to the northern, north-central, and eastern regions of Ceylon will be so enormously facilitated that we may anticipate the ancient solitudes being stirred by the voices of crowds of tourists,—tourists guided by an agent of the world-renowned Cook of Leicester! But as this is a somewhat distant contingency, we must look to the management of the steamer which is to supersede the "Serendib" for arrangements which will enable even ladies to have a look at the pearl-fishing operations, in the early stages

> Before decay's effacing fingers
> Have touched the lines where beauty lingers

of the nacre-secreting bivalves. Going by steamer to the pearl fishery, travellers could cross to Madawachchi, where the Central Road and the mail coach (a bullock coach as far as Dambulla), are met within easy distance of Anuradhapura,—by the safe, if slow, means of a bullock cart. Or, far better, if provision for horse and gig cannot be made, the visitor to the pearl fishery could provide himself with half-a-dozen coolies and three jinrikshas, one for himself and two for his bedding and commissariat. He could thus cross the northern end of the island from Mannar in the north-west to Trincomalee in the east; visiting *en route* the great tanks, Anuradhapura and Minintalé, Sigri, Dambulla, and Polonnaruwa. At Trincomalee, the visitor from Colombo and other parts of Ceylon, or the tourist from distant parts, could by arrangement meet the steamer: Trincomalee (itself an ancient place) as well as a grand port, Batticaloa and Galle being well worth seeing *en route* to Colombo. We make our good friends, Messrs. John Walker & Co. a present of these crude ideas, on which we have no doubt they will improve. A private company can lay themselves out to plan excursions and so attract passengers, after a fashion which Government could not possibly attempt. So much as to the opening up to the comparatively many of interesting scenes and strange regions, which are at present visited by only the very few.

We may now glance at some of the many interesting details connected with the natural history of the pearl oyster and the details of the fishery, which time did not permit of being even alluded to at the Conversazione on Saturday evening. One of the most formidable enemies of the pearl oysters, next to cur-

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rents laden with mud or sand, is a minute shell, a species of *modiola*; a mussel, but with the strange habit of the individuals aggregating in a sort of blanket, into which minute fragments of coral, shells, &c. are embodied. We have always compared this aggregation to the red spider on vegetation. Up to the age of one year the young oysters are in millions upon millions, destroyed by this *suran* as the Tamils call it. If, however, the pearl oysters can only manage to survive beyond the critical period of one year, they turn the table on the *modiolæ* and, instead of allowing themselves to be smothered, they eat up their enemies, literally "feeding fat" their grudge against them. The species of *balistes* called the "trigger" or "old woman" fish is also supposed to destroy far more of the *modiolæ* than of the oyster spat. But the Hon. Mr. Thomas, of the Madras Civil Service, following an idea started by Capt. Phipps of the Indian Pearl Banks, has introduced an element of doubt in the question of what is pearl oyster spat, asserting and quoting British Museum authorities in favour of his opinion, that what has always been taken for oyster spat was not "the real Simon Pure," but the young of quite a different mollusk. The correctness even of a portion of the beautiful drawings, engraved in Tennent's Natural History, is impeached. *Versus* Phipps and Thomas of Madras and the scientists, those with fullest practical knowledge of the Ceylon fisheries, Mr. Twynam and Capt. Donnan, still hold the faith which old Master Attendant Steuart held and expressed. They state that, if the masses of spat they have hitherto regarded as embryonic pearl oysters are not that, they should like to see separately the genuine spat, and this they told us they had not seen up to the date of the Jubilee fishery. The scientists, as we have said, have sided with Mr. Thomas, amongst them Mr. Haly of our Ceylon Museum, but certainly a constructive should follow a destructive theory. That the pearl oysters produce spat in enormous quantities, and that masses of such spat go floating over the Gulf of Mannar, and, perhaps, beyond its bounds is certain. But it would appear that, simultaneously, masses of the mature shell of *Avicula vexillum* float about and get mixed up in every sense with the oyster spat, specimens of both being placed by Mr. Thomas in the British Museum. His reference to the Museum authorities led to another result, viz., that we ought no longer to call our small pearl oyster *Avicula* (*meleagrina*) *margaritifera* that being the proper name of the large shells so extensively fished off the coasts of Australia and which yield the mother-of-pearl, out of which so many ornamental and useful articles are manufactured, including knife handles, buttons, papier mâché inlaying, &c. Our small oyster (3½ inches in diameter at its largest, instead of 1 foot and more) ought to be distinguished as *Avicula* (*meleagrina*) *fucata*. In each case the lovely lustre, white with just a suspicion of pink, is due not to any pigment in the mucus secreted and calcified, but to the deposition of the nacre in films of almost inconceivable thinness, one over the other and with slight corrugations in the enamel to the interior of the shell and the pearl. Although fine pearls are occasionally found in the great *aviculæ* they are chiefly valuable for their shells, which are cut up, fashioned and polished by cunning workmen, into objects which rival gold and gems in beauty. Our small oyster is valuable not for its shells but for the gems it produces. The general opinion of scientists is that each pearl is formed over a nucleus of some minute irritating substances, on which nacre was originally laid to prevent inconvenience to the soft-fleshed animal. The nuclei have been recognized as grains of sand and diatoms, and Dr. Kelaart found on one occasion the eggs which had escaped from the creature's own ovary, coated with nacre and destined in time perhaps to assume the dimensions of valuable pearls. But in some pearls no foreign nucleus can be traced, and Captain Donnan has formed a strong opinion that the majority of pearls owe their origin to an instinct which leads the nacre secreting animal to utilize any excess of the carbonate of lime mucus in the formation of the separate beautiful spherical objects which are prized as the most chaste of "gems of purest ray serene." It seems probable too (and this fact, if it be a fact, is of great practical value as applied to fisheries,

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constituting an additional reason for not delaying a fishery for full maturity or even a close approach to it) that the oyster as it grows old (it is older at seven years than human beings are at seventy) actually absorbs the nacre of which pearls are formed. Pearls, therefore, can not only increase in size with years, but decrease as middle age is passing into the limit of life, so becoming "small by degrees and beautifully less." But there is much, nearly all, yet to learn regarding the laws (for laws there must be, however capricious existing circumstances and causes seem to us) which govern the formation, growth or decay (if decay there is) of pearls; and apart from being an interesting popular object, a large and carefully stocked and well regulated aquarium, such as we hope to see in connection with the Museum, would enable careful observers to investigate and settle such curious questions. Questions involving results of much value, too, perhaps; for we can see no reason why the pearl oyster of Ceylon should not be compelled in a sufficiently spacious aquarium, filled with sea water well saturated with carbonate of lime, to coat with nacre foreign objects carefully introduced into their "mantles," just as a mussel yields to the Chinese pearls and pearly objects of great beauty and variety.

There is much more to be said about the pearl-yielding shell-fish in which we are all at present so deeply interested. But we must close for this occasion by pressing on the attention of the public and the Government of Ceylon the provisions in connection with our Museum of an aquarium worthy of the country most distinguished for the value of its fisheries and the beauty of its pearls. The results of such a provision might be not only interesting to the public and of scientific importance, but also of great economic value. Before the fishery of 1888 has been long concluded, therefore, we hope to be able to watch the pearl oysters in their successive stages of life, *walking* up the sides of a great glass aquarium, or mooring themselves, each by its *byssus*, to blocks of coral or concrete, placed amidst the sea water: sea water constantly renewed and kept pure for the purpose.

MADRAS JUBILEE RETROSPECTS.

Pearl Fisheries.

Near the southern extremity of the Presidency lies Tuticorin, on the Gulf of Mannar, in which is a Pearl Fishery, worked on the southern shores of the Gulf by the Government of Ceylon, and on the northern shores by the Government of Madras. It enriched the Kings of Ceylon in the days Marco Polo who has recorded many quaint legends on the subject. But considerable scientific progress has been made since Marco Polo's time in exact knowledge of the habits of the oyster. The earlier researches of 1857 were made at the instance of the Ceylon Government; and those of 1884 were conducted under the orders of the Madras Government. The nature of these researches is of a scientific character that comes hardly within the scope of these notes. It is enough that they have been endorsed as an advance by leading scientists in England, and that the practical result is that from an improved knowledge of the habits of the fish it may be hoped that the fishery will be improved. Already is there promise of a most extensive fishery in 1888 or 1889, for the pearl oysters in a healthy state cover an area of coral reef five miles long, and one and-a-half or two miles wide, and so thick are they that they are clustered together in some places one over another, knee deep, and show, by experiments made from 600 to 700 oysters a square yard.

Apart from studying the fish, attention has also been given to the mode of fishing. Hitherto pearl oysters have been brought up from the bottom of the sea by native divers in exactly the same way in which they dived in the days of Marco Polo. Descending with the aid of a large stone hitched to one toe, and without any diving dress, it is natural that in 8 or 9 fathoms of water

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their stay at the bottom is usually less than a minute; and the few pearl oysters hurriedly picked up are thrown into a small net attached to the diver. Less hurried and more thorough picking is to be expected of men who in European diving dress can stay down for hours together; and experiments in this direction are being made in view to ascertaining the best means of meeting most economically the many practical difficulties with which the position is surrounded, such as the prevention of the theft of pearls, the maintenance of order amongst the large numbers assembled at a fishery, the giving to each diver an individual stimulus to exertion by a system of payment by shares, and the provision of suitable boats and gear in sufficient numbers to complete the fishery within the short time in which the weather allows of its being conducted.

The two last fisheries conducted by the Madras Government yielded in 1860 R2,50,276, and in 1861 R1,29,003; while the Ceylon fisheries from 1860 to 1884 yielded an aggregate of R20,75,211. Madras in times past has thus been far behind Ceylon in the profitableness of her Pearl Fisheries. The primary reason for this lies, however, in the natural advantages of the Ceylon position, the pearl oysters preferring the southern side of the Gulf of Manaar on account of the lee side of the island of Ceylon being sheltered from the strong current which, sweeping down the Bay of Bengal, turns westwards round the south of Ceylon, and then northwards into the Gulf of Manaar, impinging directly on the Madras side of that Gulf, while the Ceylon side is sheltered.

But any deficiencies of Madras in pearl fishery revenue have been in a large measure recouped by her uniting with her pearl fisheries a fishery for the holy shell, called the Chank. It is the *Turbinella pyrum* of naturalists. This fishery is not followed in Ceylon though the shell fish are very abundant there, but on the Madras side it has been developed from almost nothing to about R25,000 a year, and under present management is calculated to yield a steady annual revenue of about the same amount, as well as to be the training ground of the divers on whom the working of the Pearl Fisheries are dependent.—*Madras Mail.*

HOW THEY MAKE PEARL BEADS.

These are chiefly made in the department of the Seine, but a cheap and inferior quality known as German fish-pearls are manufactured in Saxony.

The practice of making hollow glass beads and filling them with pearly varnish, was in vogue at an early period among the artists of Murano, but was prohibited by the Venetian Government, because it was considered either fraudulent or dangerous to health on account of the quicksilver used. The art was however revived and improved by a French bead-maker named Jaquin, who used the scales of the small fresh-water bleak for making a pearly powder, which had all the lustre of the most beautiful pearls, and was named by him *Essence d'Orient.* He first made his beads of gypsum and covered them with the pearl-powder, but this did not answer, for the powder rubbed off the beads and adhered to the skin of the wearer. After this the beads were made of glass, covered inside with a solution of isinglas and the pearl essence, and filled with wax, which was bored through with a needle; but various improvements have been made in the manufactures since then. In 1834, a French artisan invented an opaline glass of a pearly colour, very heavy and easily fusible, which gave the beads all the different weights and forms found among real pearls. They are now filled with gum instead of wax, by which means a highly transparent effect is produced, and the surface being deadened by the vapour of hydrofluoric acid, their appearance hardly differs from that of real pearls.

Pearl beads are not made by drawing the glass out into tubes as described above, but are blown separately; one workman being able to blow as many as 6,000 of the commoner quality in a day; but if they are required to be very beautiful, he

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can produce only 1,200 or 1,500, which he makes round, pear-shaped, oil-shaped, or flat on one side as may be desired.

The bleak, whose scales are employed to make the pearl-powder, is but four inches long; 4,000 fish yield a pound of scales, and these do not produce four ounces of the essence, which is preserved for use in a solution of sal-ammoniac. This is mixed with dissolved isinglass, and blown into each globule by means of a fine glass pipe, the pearls becoming more beautiful and more valuable, the larger the quantity of essence used. Some of the best imitations fetch really good prices.

SELINA GAYE.

—*Eastern Gazette of Fashions.*

PEARLS AND THEIR STORY.

The instinct implanted in the human breast, more powerful than all others, is the love of admiration. The savage tatooes and barters his goods for beads and ostrich feathers. The Red-Indian, to be a nobleman, wears his escutcheon in his nose, and the ring that dangles there is the sign of his aristocracy. It is to create admiration of the fashionable lady, that the Parisian milliner brings all her æsthetic genius to bear. Every realm of Nature has been ransacked—the bowels of the earth have been mined, and the caverns of the deep have been explored—but the pearl stands pre-eminent, for, from the oldest ages of antiquity, it has attracted attention, and has been used as a personal adornment of rare beauty. Even the Poet uses it for a happy figure, for does not Dryden sing:—

"Errors, like straws, upon the surface flow
He who would search for *pearls*, must dive below."

It is strange there exists but *one single work* in English language devoted to the Pearl, its home, its history, its peculiarities, price, and various uses.

The Literary world, as well as the Scientific world, have recognized, in *Pearls*, the emblems most fitted to represent surpassing purity. Even in religion, no matter in what caste or creed, there has existed in Sacred Literature, and still exists, a venerable significance in allusions to pearls.

In the Pentateuch, we meet the word *Bdellium* which is derived from the Hebrew word *Bedoloch*, a product of Havilah. Gesnius, following Bochart, concurs in rendering this to mean nought but the Pearl. In the New Testament we have presented to us, in the sublime Apocalyptic Vision, the City "*whose twelve gates were twelve Pearls.*"

In a very early period, one belief existed, to wit, that Pearls were formed from drops of rain falling into the open oyster shell. It was this idea which was borrowed by Tom Moore—who stole the figure for his poem, entitled "*Peri and the Pearl.*' The opening lines run thus:—

"And precious the tear, as the rain from the sky,
Which turns into *Pearl*, as it falls in the sea."

Marbodus has also sung of them, as "Spoils of Neptune, the Indian Ocean boasts," and also adds:—

"The sea-born shell conceals the *unio* round,
Called by that name, as always single found.
One in one shell, for ne'er a larger race
Within their pearly walls, the valves embrace."

There are many ancient ideas regarding the *origin* and *virtues* of Pearls.

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Robert Herrick writes :—

"Some asked how *pearls* did grow, and where,
Then spake I to my girl
To part her lips and showed them there
The quarelets of *Pearl.*"

Burton contributes a couplet

"*Pearls* and gems of lustre bright,
All sleep beneath the wave."

Hemans, with poetic pen, has contributed towards this gem the following four lines :—

"What hid'st thou in thy treasure-caves and cells
Thou hollow sounding and mysterious main?
Pale glistening *Pearls*, and rainbow-colored shells,
Bright things did gleam unrecked of and in vain."

Shakespeae, of course, is not behind hand. In Richard III, Act I, Scene 4, we hear him laud them thus :—

"Heaps of *Pearls*
Inestimable stones, unvalued jewels
All scattered in the bottom of the sea."

An American Poet, James Percival, from across the Atlantic, sends us two lines :—

"The floor is of sand, like the mountains drift
And the *Pearl* shall spangle in the flinty shore."

Our Poet Laureate in his "Merlin and Vivian" pays the latest tribute of praise to pearls, and with this quotation we will drop the *poetic* side of its History.

"The fair *pearl-necklace* of the Queen
That burst in dancing and the pearls were spilt.
Some lost, some stolen, some as relics kept,
But never more the same two sister pearls
Ran down the silken thread to kiss each other
On her white neck."

Thus much for this gem as it figures in the Poetry of our Literature. The Pearl has its *habitat* in various seas. We have English, American, Chinese, Persian, Ceylon and Australian Pearls.

Though *white* is the general color of the Pearl, we have the *Black* pearls of Mexico, the Parti-colored Black and White Pearl of Alexandria, and the Pink Pearls, referred to by Pliny, of the Adriatic. These last are found in little shell-fishes, *myæ.*

Among the "*Famous Pearls of Antiquity*" are :—

Cleopatra Pearls—Circa B. C. 30. of Egypt.
The pearls of the wife, of Caligula—Laulia Paulina—B. C. 50.
The "Pliny Pearl" A. D. 50.
"Sir Thomas Gresham's Pearl" 1560 A. D.
Rudolph Pearls 1609 A. D.
Youssoup Pearl 1620 A. D.
The Shah Pearls 1633—1635 A. D.
Arungzeeb Pearls 1650 A. D.
The Conway Pearls 1622 A. D.
La Perigrina Pearls 1830 A. D.
The "Hope" Pearls—1839 A. D.
The Russian Pearls—1840 A. D.
The Paris Pearls—1878 A. D.

The *largest* known Pearl is one of irregular shape in Mr. Beresford Hope's Collection at the South Kensington Museum. This magnificent Pearl weighs 3 oz., has a circumference of 4½ inches, and it is surmounted by an enamelled and jewelled gold crown, forming a pendant of great value.—CHARLES.—*Madras Standard.*

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CEYLON PEARL FISHERIES

PAST FISHERIES.

The following tables give a complete résumé of the revenue receipts from Pearl Fisheries within the British era. Between 1796 and 1837 we make use of a statement shewing the revenue and expenditure only: from 1838 onwards fuller details are given. We retain the old currency of £. s. d., although the "£" is really one of ten rupees all through:—

(Statement of Revenue and Expenditure from 1796 to 1837, compiled by the late Mr. J. L. Siebel, Chief Clerk of the Colonial Secretary's Office, for the information of Sir Henry Ward.)

Years.	*Receipts.*			*Expenditure.*		
1796	...£60000	0	0	—		
1797	...110000	0	0	—		
1798	...140000	0	0	—		
1799	... 32063	4	6	...7188	18	0
1801	... 15022	13	8	...2200	16	0
1803	... 16315	7	6	...1057	17	6
1804	... 77020	3	10	...2347	9	0
1806	... 41284	5	8	...1339	12	1
1808	... 84257	14	8	...1963	12	10
1809	... 27246	7	8	... 655	12	0
1814	...105187	12	5	...3634	6	0
1815	... 584	4	9	... 159	0	0
1816	... 926	11	2	... 550	0	0
1820	... 3040	19	6	... 483	0	0
1823	...No Fishery			300	0	0
1824				300	0	0
1825	... No Fishery			... 300	0	0
1826				... 669	0	0
1827				... 768	0	0
1828	...30523	7	5¾	...1651	2	2
1829	...38273	14	4	...1166	1	0
1830	...22256	9	0½	... 926	10	0
1831	...29336	11	8¼	...1204	11	0
1832	... 4581	0	0	...1100	19	6¼
1833	...32089	10	11	...7550	13	4
1834	...No Fishery.			... 449	0	0
1835	...40346	0	9	...5586	2	5¼
1836	...25816	3	11½	...5826	4	5
1837	...10631	4	9¾	...2373	19	5
Total	£946,803	8	3¾	51,752	6	8½

The following return is taken from Capt. Steuart's Account of the Pearl Fisheries, and, although chiefly given in old Indian currency, it makes up a total somewhat different from the foregoing:—

Year.		*Receipts.*			*Expenditure.*		
1796 ...	Porto Nova Pagodas	98,926	12	31	... 5,203	4	52
1797 ...	do. do.	330,620	4	74	... 1,918	3	15
1798 ...	do. do.	380,748	28	6	... 12,729	17	57
1799 ...	Star Pagodas	94,254	16	62	... 32,068	25	5
1801 ...	do. do.	37,556	31	1	... 5,501	44	2
1803*a* ...	Porto Nova Pagodas	43,459	29	3	... 2,821	15	0
1804 ...	do. do.	190,144	27	0	... 5,796	12	0
1806 ...	Rix Dollars	386,997	10	2	... 12,516	6	0
1808 ...	Porto Nova Pagodas	242,086	48	0	... 5,643	45	0
1809 ..	do. do.	73.173	37	0	... 1,759	41	40
1814 ...	Rix Dollars	1,202,052	6	1	... 41,443	1	3
1815*a* ...	do.	4,858	0	3¾	Net proceeds (not given)		
1816 ...	do.	47,361	10	1	... 43,275	11	2¾
1820 ...	do.	34,753	9	0	... 5,520	2	2½
1828 ...	Madras Rupees	327,550	12	2¾	... 15,594	10	1½
1829 ..	do.	407,570	12	0	... 10,304	15	7
1830 ...	do.	251,915	0	0	 8,224	7	3 6/7
1831 ...	do.	328,758	0	0	... 11,293	14	5 4/7
1832*b* ...	... ...	£4,581	0	0	... £711	1	7¼
1833 ...	... ...	£32,059	10	11	... £7,016	0	11
1835 ...	... ...	£40,346	0	9	... £2,099	0	0
1836 ...	... ...	£25,816	3	11½	... £2,280	8	1¾
1837 ...	... ...	£10,631	4	9¾	... £1,233	9	4½

Capt. Steuart makes the total net revenue from 1796 to 1837 inclusive £524,521 14s. 2¾d., against £585,000 according to Mr. Siebel's Statement.

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Year.	No. of Oysters Fished.	Sold for Govt.	Average rate per 1,000. £	s.	d.	Total Revenue. £	s.	d.	Expenditure. £	s.	d.	No. of Fishing Days.
1838 to 1854	No regular Fishery	....	....	...	...	2,006	0	0	8,639	0	0	
1855	6,743,762	5,051,818	2	3	3	10,922	1	0	2,632	0	0	
1856	No Fishery	... .	......	...	...	...			905	11	7	..
1857	32,453,053	24,380,308	0	16	8½	20,363	6	6	4,428	0	0	23
1858	16,484,861	12,353,049	1	19	0	24,120	0	2	4,741	16	2¼	18
1859	4,191,465	3,143,402	6	3	9	48,215	18	10	4,830	10	0	18
1860	3,644,994	2,743,467	12	17	10	36,681	12	4	3,828	0	0	14
1861	No Fishery	....	.....	......		...			1,297	13	0	...
1862	Do	....	......	......		...			2,476	0	8	...
1863	11,695,794	8,779,414	5	16	0	51,017	17	5	5,019	0	0	22
From 1864 to 1869	No Fishery	...		...		...			11,415 ... 5,188	3 ... 11	9c ... 4d	
1870	Do	...		...		...			1,666	12	2½c	
1871									759	9	9c	
1872									523	0	0c	„
1873									2,208	5	9c	
1874	1,699,669	1,275,706	7	18	0	10,119	18	0	2,852	7	5	
1875	...	...		...		...			793	12	8	15
1876	No Fishery	...		...		...			1,012	5	0	
1877	6,849,720e	5,137,290	3	13	8½	18,952	2	0	4,889	4	1½	30
1878	No Fishery	...		...		...			4,466	14	8½f	
1879	7,645,901	4,127,165	1	9	2	g9,424	13	8	4,181	7	9	12
1880	35,288,466	25,927,229	0	15	4	20,000	0	0	8,668	2	7	33
1881	27,338,593	18,225,781	3	5	8	59,868	16	0	8,500	0	0	47
1882	No	Fishery.		—		—			884	0	0	
1883	No	Fishery.		—		—				—		—
1884	1,794,028	1,262,686	2	12	8½	3,321	15	8	733	11	6½	40
1885	No	Fishery.		—		1,000	4	0	—			—
1886	No	Fishery.		—		1,061	18	0	—			—
1887	30,947,905	20,631,937	1	18	4¾	39,609	11	1¾	4,609	11	1¾h	26i
Total	156,728,714	138,539,202	2	16	3	356,685	8	9	98,156	1	9½	

a This was off Chilaw fished in April and November.
b Off Karetivu *c* Inspections, &c. *d* Naturalist. *e* Sample 10,000.
f A Sailing vessel was voted this year for the protection of the Pearl Banks, but it has not been bought yet; a new boiler was purchased for the steam launch.
g Included in this amount, are the proceeds of a number of pearls retained by Government after the Fishery and sold by the Treasurer, which realized £3,355-5-8, deducting all expense, commission, &c.
h Estimate. *i* 20 full, and 6 partial, fishing days.

OUR PEARL FISHERY.—We have now received, through the courtesy of Mr. Twynam, Government Agent Northern Province and Superintendent of the Pearl Fishery, a correct manuscript statement of the results of our late Fishery prepared from the official records. This statement we carefully reproduce as follows:—

THE CEYLON PEARL FISHERY OF 1887.

Date.			No. of Oysters Fished.	Sold for Govt.	Average rate per 1,000	Revenue.	
April 2	...	...	1,263,540	842,360	R21·69	R18,277	94
„ 3	...	...	1,396,753	931,169	15·00	13,967	54
„ 4	...	...	1,282,475	854,988	17·65	15,097	69
„ 5	...	...	1,020,810	680,540	19·68	13,394	30
„ 6	...	...	854,677	569,785	18·02	10,270	63

Date.			No. of Oysters Fished.	Sold for Govt.	Average rate per 1,000	Revenue.	
April 7	...	...	821,483	547,655	18·01	9,863	62
" 8	...	...	937,177	624,785	19·08	11,925	02
" 9	...	...	857,415	571,610	19·01	10,868	09
" 11	...	...	1,897,515	1,265,010	20·49	25,925	21
" 12	...	...	1,347,443	898,295	19·65	17,654	75
" 13	...	...	1,452,787	968,525	20·11	19,485	26
" 14	...	...	1,716,600	1,144,400	21·46	24,566	80
" 15	...	...	2,300,168	1,533,445	24·20	37,123	46
" 16	...	...	2,392,702	1,595,135	14·95	23,854	60
" 18	...	...	1,964,573	1,309,715	16·38	21,455	80
" 19	...	...	1,751,257	1,167,505	21·74	25,391	60
" 20	...	...	1,618,530	1,079,020	20·75	22,400	40
" 21	...	...	1,619,708	1,079,805	20·17	21,786	00
" 22	...	...	75,555	50,370	20·90	1,053	59
" 23	...	...	1,785,750	1,190,500	19·41	23,114	00
" 24	...	...	1,809,945	1,206,630	16·14	19,479	49
" 25	...	...	486,427	324,285	17.00	5,512	85
" 26	...	...	22,890	15,260	18·00	274	68
May 2	...	...	26,490	17,660	29·40	519	30
" 6	...	...	166,313	110,875	17·00	1,885	88
" 7	...	...	78,922	52,615	18·00	947	07
			30,947,995	20,631,937	19·19	R.396,095	57
			Proceeds sale of sample pearls			530	50
					Grand Total	R396,626	07

The gross result of the Fishery was therefore very nearly four lakhs of rupees while after defraying all expenses the general revenue has doubtless profited by as much as R350,000. This compares well with the average of Pearl Fisheries in Sir Henry Ward's, or since his time. This may be judged from the full statistical résumé of the results of Ceylon Pearl Fisheries in the British era, which we give on page 542. It will be seen that although the total of oysters fished and sold for Government this year was considerably higher than at the Fishery of 1881, yet the pearls were so much better then—the oysters being probably older—that the net result was R510,000 against the R350,000 just realized. In 1863, the net revenue was R460,000 from less than one-third the number of oysters sold this year, and in 1860 nearly as much money was got as in 1887, from only 2¼ millions of oysters against 20 millions this year!

CAPTAIN DONNAN'S OFFICIAL REPORT OF THE RECENT INSPECTION.

Colonial Secretary's Office, Colombo, 7th Dec. 1887.

To the Editor "Ceylon Observer."

Sir,—I am directed to transmit to you a copy of a report by Captain Donnan of the result of his recent inspection of the pearl banks off Arippu and the island of Karaitivu.—I am sir, your obedient servant, A. M. ASHMORE, for Colonial Secretary.

Master Attendant's Office, Colombo, 1st Dec. 1887.

Recent Inspection of Pearl Banks

The Hon. the Colonial Secretary.

Sir,—I have the honour to report my return to Colombo on the 30th November from an inspection of some of the pearl-oyster beds off Arippu, and the island of Karaitivu.

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2. The chief object of the inspection was to examine the beds of oysters on the Cheval Par, and to lift from them and wash a sample of oysters, in order to test their value and publish a notice of the intended fishery during the next N. E. monsoon; but some other banks besides the Cheval were examined, viz. the part of the Periya Par which was fished in 1879, the Periya and Parkarai, the Vankalai Par, and the Motarakam Par off Arippu, and the Karaitivu Par and Muttuvaralu Par off the island of Karaitivu.

3. The Cheval Par was found to contain extensive beds of oysters of four years, or four years and three months old, both on the east and west sides of it. In all an area of about 21,746,745 superficial yards, containing about 164,429,684 oysters. I sub-divided the east side into three parts, north, south, and centre; and the west side into two parts, north and south, as the oysters on the centre part of the east side and north part of the west side seemed to be smaller than on the other parts, but the sample lifted from the north part of the west side proved the most valuable of all.

4. The north part of the east side of Cheval which was partially fished in April last was found to have an area of oysters of about 2,770,438 superficial yards, containing about 17,315,225 oysters. The oysters on it averaged 25 to a dive, and 6 per cent of dead shells were found. From this part of the bank a sample of 12,053 oysters was washed. The yield of pearls weighed 8 kalangies and 16 12-16ths manjadies, valued at R218, which gives a value of R18·09 and 14·52 manjadies of pearls per thousand oysters.

5. The south part of east side of Cheval was found to have an area of oysters of about 4,882,500 superficial yards, containing about 35,398,025 oysters. The oysters on it averaged 29 to a dive, and 4 per cent of dead shells were found. From this part of the bank a sample of 12,060 oysters was washed. The yield of pearls weighed 7 kalangies and 13 6-16ths manjadies valued at R172, which gives a value of R14·27 and 12·60 manjadies of pearls per thousand oysters.

6. The centre part of east side of Cheval was found to have an area of oysters of about 5,382,938 superficial yards, containing about 64,595,232 oysters. The oysters on it averaged 48 to a dive, and only ½ per cent of dead shells were found. From this part of the bank a sample of 12,016 oysters was washed. The yield of pearls weighed 3 kalangies and 17 manjadies valued at R78·25, which gives a value of R6·51 aud 6·41 manjadies of pearls per thousand oysters. This sample gave the smallest yield of pearls and least value of all the samples lifted.

7. The north part of west side of Cheval was found to have an area of oysters of about 4,383,875 superficial yards, containing about 21,919,360 oysters. The oysters on it averaged 20 to a dive, and 3 per cent of dead shells were found. From this part of the bank a sample of 12,180 oysters was washed. The yield of pearls weighed 8 kalangies and 19 15-16ths manjadies, valued at R225, which gives a value of R18·45 and 14·45 manjadies of pearls per thousand oysters.

8. The south part of west side of Cheval was found to have an area of oysters of about 4,326,994 superficial yards, containing about 25,201,842 oysters. The oysters on it averaged 24 to a dive, and 3 per cent of dead shells were found. From this part of the bank a sample of 12,110 oysters was washed. The yield of pearls weighed 8 kalangies and 13 7-16ths manjadies, valued at R212, which gives a value of R17·50, and 14·12 manjadies of pearls per thousand oysters.

9. The small produce of pearls and low valuation of the sample lifted from the central part of the east side of Cheval proves that the oysters on it are not yet sufficiently matured for fishing, and when I met Mr. Twynam at Silavatturai we both agreed to recommend that portion of the bank being kept for fishing in March 1889. Although the oysters on the other parts of the Cheval are not of full age they are sufficiently advanced to afford a profitable fishery next season, and excluding the estimated number of oysters on the central part of the east side of Cheval there remains on the other parts

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an estimated number of 99,834,452 of oysters, having an average value of R17·08 per thousand, and that number is considerably more than it is likely to be possible to fish in one season under the most favourable circumstances.

10. On the Motarakam, Par which was fished last April, I found about 3,206,250 oysters still remaining which are available for fishing next season should an opportunity of doing so occur.

11. On the Periya Par Karai and Vankalu Par I found a small patch of oysters about two years old, but they were not sufficiently numerous to become of any value.

12. On the Karaitivu Par I found a small bed of three years old oysters containing about 1,605,465 oysters averaging 15 to a dive.

13. On the Muttuvaratu Par which lies about six miles to the north-west of Dutch Bay, I found a splendid bank of three years old oysters, having an area of about 7,320,600 superficial yards, containing about 49,414,050 oysters, averaging 27 to a dive. The oysters were firm on very suitable rocky ground. I have great hope of this bank affording a handsome fishery in 1890, although there is no record of its having ever yielded a fishery.

14. On the west side of the Cheval the old oysters on nearly every part of it were covered with young oysters about three months old, attached to them so thickly that on several oysters I counted from 60 to 125 young ones. These young oysters will cause some extra labour to the men in the diving boats during the next fishery, as it will be necessary to have them pulled of the old oysters as they are brought up and thrown overboard again, and this will no doubt cause the destruction of an immense number of them. Similar young oysters were found thickly spread over the Periya Par fishing ground of 1879.—I am, &c.,

(Signed) J. DONNAN,
Inspector, Pearl Banks.

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(*From the "Ceylon Observer," January* 11*th*, 1887.)

Discovery of a Large Alexandrite.—Galle, 10th January.—From Weligama comes the news that a Moorish priest (Mowlana) has found an Alexandrite weighing 1,876 carats, for which he has declined an offer of R10,000. It is his intention to cut the stone into suitable sizes.

THE CEYLON ALEXANDRITE.

(*From the "Ceylon Observer," January* 11*th*, 1888.)

The large alexandrite you refer to was sold for R10,250, the purchasers being three Moorish gem merchants of Galle. When Sir Arthur Gordon was last here, he expressed a wish to see the stone; but it had then been cut into three pieces. Mr. A. L. M. Wil Cassim, the Shroff Mudaliyar of the Kachcheri, accompanied by one of the shareholders, waited on His Excellency at Plaisance (the Government Agent's residence) and exhibited the gem. The Alexandrite, however, failed to attract the attention which its owners expected it would do, as the cutting and polishing processes, which contribute in a great measure to display the remarkable properties of the gem, had not been completed. Subsequently the stone was cut in pieces to suit the requirements of customers and exported to Europe for sale.

It is about 15 years ago since the Ceylon alexandrite first attracted notice in London and created a demand for it, which the Moorish gem merchants of Galle did not fail to take advantage of. Previous to that, the dealers were quite ignorant of the value of the stone or of its peculiar properties (dark green, which is changed to a ruby color when exposed to artificial light), and it was no uncommon circumstance for them to burn the stone and try to palm it off on passengers by the steamers. It was always considered a very superior specimen of tourmaline, until one of the native merchants, more enterprising than the rest, consigned a parcel to London, invoicing the contents as "green sapphires." The sale of this lot at £2 10s a carat opened the eyes of the 'cute dealers down south, as somehow the secret leaked out and there was quite a rush for the article. Subsequently much higher prices were realized as the demand for alexandrites steadily increased. Hitherto, the largest find has been in the Weligama district, the Moorish priest (or Mowlana) owning the richest pits.

A SINHALESE, MR. DE SILVA, AND SOUTH AUSTRALIAN RUBY MINES.

To the Editor "Ceylon Observer."

Gawler Place, Adelaide, 16th Dec. 1887.

Dear Sir,—By this mail I send you an Adelaide paper in which you will notice we have a Sinhalese named De Silva here, taking an active part in connection with the ruby mines lately discovered at Mount Pleasant.

It appears he came from Port Darwin only a few months since to push the sale of Ceylon and Indian fancy goods, but not succeeding so well as he expected, he turned his attention to mining and has invested in a considerable number of shares. He is also supplying Sinhalese for the working of mines, but it remains to be seen how the Sinhalese will get on with European labourers.—Yours faithfully,

A. M. DRUMMOND.

[We append the extract referred to, and some others.—Compilers.]

On Thursday, December 10th, a party of seven gentlemen from Adelaide, including Mr. W. H. Stevenson (of Messrs. Stevenson Bros.), the secretary of the company (Mr. A. J. Barnes), and Mr. M. V. De Silva (from Ceylon, precious stone

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merchant and expert) paid a visit of inspection to the claim owned by the Una Ruby Company, near Mount Pleasant. On arrival Mr. De Silva, by means of testing, advised the men at work where to try and wash for rubies. In doing so the wash dirt was found to contain several rubies and ruby garnets, also an amethyst and a white sapphire. The Sinhalese expressed himself as highly pleased with the richness of the company's porperty. The party returned on Friday, bringing home some excellent samples of the precious stones. Since their return Mr. De Silva has sent the following report to the secretary:—"Having visited and examined the Una Ruby claim at Mount Pleasant, I beg to report that I searched for rubies and other precious stones. From three or four dishes of the surface soil, I obtained a large number of rubies (including the oriental), garnets, an amethyst, and a white sapphire. These being so readily obtained from the surface, I am certain of the existence of large rubies and various precious stones further down, which will be obtained by sinking. The indications in all parts of the claim are much richer in precious stones than the gem mines of Ceylon, in which I was engaged for seven years." The directors, believing in the richness of the property, have two gem miners from the gem mines of Ceylon to assist in working for precious stones, who proceed to the claim at once. In another column appears the prospectus of the Excelsior Ruby Company. This company is being formed to work mineral claim No. 11,278, situated near Mount Pleasant, and to prosecute a search for rubies, precious stones, and minerals. The capital is to be £30,000 in 30,000 shares of £1 each. It is stated in the advertisement that half the shares have been applied for.

(*From the Prospectus.*)

Owing to the signal success which has followed the floating of tho Una Ruby Company (Limited,) whose claim has been so highly reported upon by Mr. M. V. De Silva, precious stone expert from Ceylon, the proprietors of this claim have great faith in submitting it to the general public as a limited company.

It is intended to purchase from the present proprietors the Claim No. 11,278, situated near Mount Pleasant, and within 20 chains of the Una Company's Property, to search for rubies, precious stones, and minerals, several of which have been obtained from this claim during the past week, of which many are pronounced by Mr. De Silva to be pure rubies, which may be seen at No. 10 Waterhouse Chambers, Adelaide. Mr. De Silva in a report upon this property says he is certain of the existence of rubies and other precious stones from the indications and wash dirt obtained by him, the surface indications being much richer than the gem mines of Ceylon, in which he was engaged for seven years.

In consequence of the numerous precious stones that are likely to be obtained from this and the adjoining claims, Mr. De Silva has decided upon bringing out a "lapidary" from Singapore to dress the stones for the market, who will arrive in the course of a week or two, and he has also agreed to bring out gem miners to work the property (if required.)

The claim which has been surveyed contains about 60 acres, and has two gullies or watercourses, from which the precious stones are obtained; and it is also confidently believed that the rock which forms their matrix is situated upon the claim.

From the *South Australasian Register* we take further extracts which shew that "ruby-mining" is to become a big thing in this colony:—

RUBY MINING IN AUSTRALIA.

THE MACDONNELL RANGE RUBIES.

The Directors of the MacDonnell Range (Pearson's) Ruby Company have received the following letter from Mr. Richard Pearson, dated London, November 3rd:—"The news I have to tell you this week is better than ever. Messrs. Haslack Brothers have increased their offer to 35s per carat for all stones under a carat. They will cost us 5s per carat to cut. For the stone I had cut in Ceylon and repolished here they offer £7. It is just over 1 carat in weight. For all like it and about the same size £6 to £10 per carat, consequently I have put in hand a good many for my first orders, as they will buy at once some hundreds, and if of lighter colour than the samples, they will give as much as £20 for stones of 1 carat. Some that I am having cut are of lighter colour, and between 2 to 4 carats in weight, so I hope to be able to telegraph you good sales long before you get this. The strange thing about our stones is

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that they are all rubies, and not like those from Burmah and other places mixed with garnets. I went the other day to Messrs. Brown and Luugley, large ruby lapidaries, to see if they would report the same as did Ford Wright, and now I can see how it was that our Adelaide jewellers fell into the error about the stones. I asked if they would give me a price for cutting, showing them a few of our stones, and looking at them this lapidary said, 'Oh, yes, 1s 6d, they are only Cape rubies (that is kind of hard garnet as is known), but let me try it first.' On coming back in a few moments he said 'I beg your pardon, but I made a mistake; if you come in tomorrow I will tell you the price for cutting them, as I find it is a ruby.' I went in next day, and he said it would cost 5s pêr carat for the stone of 1 carat, 'Now,' I said, 'are you quite sure it is not a garnet?' and he replied—'I am quite sure; but they at first sight look like garnets or Cape rubies. However, it is easy to tell when you come to try them; the only true test is to try to polish on the wheel we polish garnets and Cape rubies on, but that wheel would not touch your stones, and we could only polish them on the diamond and Oriental ruby wheel, which is a metallic one, and would at once destroy a garnet. This wheel is only used for diamonds and rubies.' He stated that the stone is a ruby of fine colour, much harder than a spinel, and as hard as many Burmah rubies. Now I think that I have proved beyond a doubt that our stones are rubies, and as I have already started one order at good prices for Messrs. Haslack Brothers and others on the samples, it proves that they are of great commercial value, and before long our Company will be paying good dividends. All the brokers I have seen tell me that they will be large buyers of the stones. The Bank people asked me if I would allow the newspaper people to telegraph it out, but up to the present time I have refused to let them do so. Mr. L. A. Withall tells me that he is very pleased that I came home, as he did not get good reports on the few stones which he took with him, but as he sent them to 'the stores' and they sent them somewhere, he could hardly expect much. There are three or four people here who wish to buy into the Company, but with the exception of a few shares which I have sold at £1 each I intend waiting until I know how the Adelaide market goes. I hope the shares are above £10—they ought to be on the prospects. I am glad to say that everything has turned out even better than I expected. Messrs. Harold Brothers are very pleased at the result, and tell me that Haslack Brothers are the best men I could deal with; they are brothers-in-law of Dr. Popham, of Gawler. I have been offered office accommodation free by some firms here, but I expect to take two rooms in Clerkenwell, and expect to have some large stones cut, but the very small ones I will have cut in Germany or Amsterdam. The first few hundreds I will have cut here by the first cutters in London." We are informed that Mr. Brooks, of Messrs. Ashford and Brooks, has informed his brother, of this city, by letter received on Monday, that the information given by Mr. R. Pearson with regard to the stones is quite correct. The Directors further wish to carry on the history of the ruby transactions in London by giving the telegraphic information received subsequent to the above letter. By telegraph, dated London, November 15th, Mr. R. Pearson asked, "Should I be offered £5,000 for whole may I accept?" To this the Directors cabled that they expected a great deal more, but left it to his judgment, asking him how many stones he had sold, and what amount of money he had received. Mr. Pearson replied on November 19th as follows:—"Fifty cut, £70; no better offer."

RUBIES AND THE FAR NORTH COUNTRY.—Evidence relative to existence of rubies in considerable quantities in the Far North country is now rapidly accumulating. Of course a great many of the statements and estimates which pass current among excited speculators are to be taken with extreme caution. It is not likely that precious stones of great value should be scattered over so large a space of territory as some sanguine people seem to suppose, or that they can be obtained at a very small outlay in labour and money. But the main point to be determined is as to whether the genuine ruby as found in Eastern countries, and highly prized in every part of the world, is to be procured within South Australian territory; and in reference to this question there is now very little room for doubt. Our readers have probably closely observed the telegrams and letters which have appeared in our columns in reference to the visit of Mr. Richard Pearson to England, and the samples of stone which he has taken to London with him. It will be noticed that very severe

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comments are made by some of the shareholders on his unbusinesslike and, in some respects, questionable way of placing them on the market. But the names of well-known British experts have been published as the authorities for the assertion that the stones submitted to them are true rubies. Prices have been offered and given which show that a high value is set upon them in the London market. Private telegrams have been received by persons of undoubted caution and veracity confirming the assertion that satisfactory sales have been concluded. There is good reason by this time not only to hope but also to believe that the discovery is a genuine one. On no other grounds can the facts and statements be explained except it be the existence of a plot of so extraordinary a nature that it is difficult to conceive how it could be carried out.

A ruby mine is necessarily somewhat of a lottery. When Mr. Streeter offered a high rent for the right to work the mines in the recently acquired British territory in Burmah, opinions differed in a remarkable degree as to the nature of the bargain he was proposing to make. Yet it is certain that the rulers of Burmah and Siam have been accustomed to extract from the ruby mines large revenues in the shape of rents and royalties. In South Australia—or, rather, in the Northern Territory, for it is in that part of the colony that the MacDonnell Ranges are situated—perhaps the greatest service which the development of ruby mines would confer would consist in its attracting population to large tracts of country which in every respect deserve more attention than they have hitherto received. The total area confined within the province is 903,690 square miles, or no less than fifteen times the area of England and Wales combined. Of this vast extent of territory perhaps one-tenth has been moderately well examined in the search for its mineral wealth. The rest lies practically unexplored, and certainly quite undeveloped. The MacDonnell Ranges are believed to be rich not only in precious stones, but also in metals. They are situated almost exactly on the line of the tropic of Capricorn—a position which corresponds very closely with that of the Burmese ruby-mining territory in the Northern Hemisphere. It should not be forgotten, however, that until the Transcontinental Railway has been somewhat further advanced than it is, the cost of carriage to the MacDonnell Range country will necessarily be very great. The distance from Adelaide is almost exactly 1,000 miles, and the railway journey to the terminus at the Peake is only 665 miles. Even when the recently authorized extension to Angle Pole has been accomplished there will still be about 300 miles to be traversed by conveyance. Of course, weight for value, no commodities are easier to carry than precious stones. But the carriage of provisions and other stores will for a considerable time to come be very costly. At present the extent of the ruby country is quite a matter of conjecture, but should the genuineness of the various samples of stones sent to London be established beyond doubt there will be good reason for a movement of population in the direction of the MacDonnell Ranges. The consequence will be that the mineral wealth of a large extent of new territory will be prospected, and it will be very surprising if some valuable discoveries are not made. Indications of silver, tin, and copper have already been seen in the neighbourhood, and some of the country is described as of a very likely character for the presence of gold. The year 1888 will probably witness material progress in the opening up of the Far North. The people of South Australia are taking heart again. With a rising market for wheat, wool, and copper they have some reason to hope for better fortune as regards the land that is already developed, and the progress of recent discovery tends to show that only a small proportion of the field of the colony's real worth has yet been tested.

THE SOUTH AUSTRALIN RUBIES.

(*Adelaide Observer*, Jan. 9th, 1888.)

Our London correspondent, writing under date December 2nd:—There is no longer any doubt concerning the value of the rubies which Mr. Pearson, of Adelaide, as representing the MacDonnell Ranges Ruby Mining Company, has introduced to this country. Some of them have been already cut and set with diamonds, and have evoked unqualified admiration. They have been shown to the Agents-General, who have expressed astonishment at their beauty, and have been on view at the Royal Colonial Institute, where their presence excites great admiration, and where Mr. Pearson was closely examined as to his dis-

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coveries, and suddenly found himself a lion among a crowd of colonial notabilities, including Mr. Denniston Wood and Mr. Frederick Young. In addition to these admiring testimonials Hasluck Brothers, the well-known export brokers of Hatton Garden, have given Mr. Pearson a favourable report, from which I make the following extracts:—"After sending them to the lapidaries we came to the conclusion that the Company had made a valuable discovery, and possess stones which will sell freely at high prices. A large quantity of these stones have been cut, and are gradually being introduced to the London market, and there is no doubt in time they will command a ready sale, for many of them are of extreme beauty." But you will be able to judge of the value of this testimony personally, as by the present mail a ring of rubies and diamonds, with several single specimens of rubies selected indiscriminately from the large number brought home, are being forwarded to Mr. Crawford Pearson. It is a fact that up to the present no garnet has yet been found in the several parcels, and that a pewterwheel will not polish the cut stones, while any known Cape garnet will be polished by that method. The brokers have offered to take 200 rubies a week from the Company when once they are started on the public. They told me that they valued them at (by the carat) between £2 and £3, and that according to this computation the Company have in this country nearly £100,000 worth. They further call them ballroom stones, almost akin in quality to the Siamese ruby. The brokers further assert that they believe that Mr. Pearson has no stone with him which would not pay for cutting. I have been asked to bear testimony to the geological knowledge of Mr. Govett, of Adelaide, whose favourable report upon the rubies when in the colony has been confirmed in almost every particular by the London experts, both in respect to hardness and quality.

RUBY MINING.

MORE RUBIES.—A few weeks ago a sample of rubies from the Maude River, near Alice Springs, was received in Adelaide from Oliver's claims. Mr. Oliver subsequently sold four-fifths of his interest in the claims, and 60,000 stones equal to the sample sent. The balance of the rubies (over 100 lb. in weight) arrived in Adelaide by the North train on Tuesday night, and have been deposited for safety in one of the Banks.

MACDONNELL RANGES RUBY-MINING CO.—The Directors by mail on Tuesday received letters from their agent, Mr. Richard Pearson, reporting further progress in the matter of disposing of the Company's rubies, and enclosing the following reports from experts:—"104, Hatton Garden, London, E. C., December 1st, 1887. The MacDonnell Ranges Ruby Mining Co. Gentlemen—In handing you the half-hoop ring made from your Australian rubies and two of our brilliants, we think it as well to state what we know of the rubies in the ring. The rough rubies were shown us by Mr. Richard Pearson, and at our introduction he took them to a firm of lapidaries in this city for the purpose of having them cut and polished. We also called on the lapidaries and gave them instructions as to shapes and style of cutting. A long conversation ensued, and we came to the conclusion that the Company has made a valuable discovery, and possesses stones which will sell freely at high prices. A large quantity of these stones have been cut, and are gradually being introduced to the London market, and there is no doubt in time they will command a ready sale, for many of them are of extreme beauty. We are, gentlemen, yours truly, HASLUCK BROS." "St. John's Lapidary Works, St. John's-square, London. To Mr. Richard Pearson. Having reference to the stones we have been cutting, we find them rubies, softer than the Oriental, but much harder than the Cape ruby, and from their brilliancy and unique colour should consider them to be a valuable addition to the list of gems already known. BROWN AND LANGLEY, Lapidists." The ring and cut rubies are now on view at the Exhibition, also a few samples of the stones recently brought down by the Company. When the Exhibition closes they will be shown at the Company's Office, Piriestreet.

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PRECIOUS STONES OF THE UNITED STATES.

(*From "Ceylon Observer," Jany. 25th,* 1888.)

These are described in a very interesting article in the Christmas number of *Harper's Magazine.* This article we now transfer to our compilation, and we only regret we cannot reproduce the truly beautiful coloured lithograph in which the typical gems and crystals are portrayed. The first is the diamond, which exists, but does not abound, in the United States. Then there are sapphires in different forms, one in the matrix, corundum being pretty common in the United States, and utilized for polishing purposes. Topaz is next figured, and then a truly magnificent beryl or emerald crystal, the largest known, its length being 8½ inches. Next in size is a specimen of tourmaline, a gem which in the United States assumes dimensions and displays beauty of colouring which leave all Ceylon specimens far behind. A beryl or aquamarina of 133¾ carats is figured, and a lovely yellow or golden beryl. Specimens of garnets, "the finest in the world" are figured, and also of "green peridot, or Job's tears," which are found associated with them, and which are said to be carried to the tops of anthills, not only by the ants, but *by scorpions!* The statement is gravely made, with no attempt at explanation. How either ants or scorpions could carry gems of any size, or why they should do so, we cannot see. A gem which has been named "Hiddenite" is said to be peculiar to the United States. It is a silicate of alumina and very beautiful. A fine amethyst is figured, and a "cairngorm" or smoky topaz, following which we have turquoise in the matrix. Then we have figures of Indian arrowheads, formed of rock crystal, jaspar and chalcedony. A very fine fresh-water pearl is finally shown on the page of illustrations, which is itself "a thing of beauty." Many gems and crystals beyond those figured are described in the paper, *many* of which are said to be peculiar to the United States, where as in other auriferous countries gems are found associated with gold. Fragments of diamonds are often found in the debris operated on by the stampers used in reducing auriferous rock. The curious fact is mentioned that gems which are blue, green and other colours by daylight all show red in artificial light. They must be allied to the Ceylon "alexandrite." Crystals of spinel, the finest the world has ever known, some of them over 6 inches in diameter, (!) have been mined in America. Proper search in our own mountain limestone might reveal fine spinels. *Opaque* crystals of topaz one foot square have been found. Quartz crystals penetrated by black hornblende and moss agates are very beautiful, as also polished pieces of fossil corals. Silicified woods have yielded sections rich and varied in colour and 29 inches in diameter for table tops. The "rutiles" (pure titanic acid) of America are said to "lead the world," and lodestone of great magnetic power exists. Of jet, masses 1 foot long, an inch thick, and four inches wide abound. What is said about the fresh-water pearls is very interesting in connection with our own sea pearls.

PRECIOUS STONES IN THE UNITED STATES.

BY GEORGE F. KUNZ.

(*From "Harper's Magazine," X'mas Number, 1887.*)

[We regret we cannot reproduce the plates and figures referred to in this paper.—COMPILERS.]

Although nearly all the known varieties of gems have been found in the United States, and some of them in exceptionally fine specimens, their total value is very small, in comparison with the great extent of the field. But while this is not a gem-producing country, a *resume* of what has been found here will undoubtedly be of interest, especially as many stones are peculiar to the United States. Very little systematic mining or working for gems and precious stones has ever been done in this country. In most of the gem localities, they

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are either of accidental occurrence, or are found where other materials are being mined in occasional veins or pockets. They are often gathered with little system on the surface, as are the garnet and peridot in Arizona and New Mexico, or collected in the beds of streams, or from decomposing rocks, as is the moss agate in Wyoming Territory, or on beaches, as the agate, chlorastrolite, and thomsonite at Lake Superior. Nearly all the gems thus found are sent to the large cities for sale, sold to the visiting tourists, or sent to other tourist resorts, to be sold as curios from that vicinity. Many of these gems are only known locally or to mineralogists. Some of them never circulate beyond the gem collectors of the United States, whose one objeet is to enrich their cabinets, with something that possesses the qualities of a precious stone, viz., beauty and durability.

Diamonds have occasionally been found at a number of localities in the United States but the crystals are of infrequent occurrence, and never in sufficient quantities, to warrant any extended mining for them. The total number found is not more than two hundred. The largest authenticated diamond crystal was found opposite Richmond, at Manchester, Chesterfield County, Virginia, by a laborer engaged in grading the streets. Its original weight was 23¾ carats, but it had a large flaw in one side, and had been injured by the finder putting it into an iron furnace, in order to prove its genuineness. A facsimile of this diamond is represented in Fig. 1 on the colored plate. After cutting, it weighed 11⅜ carats. It passed into the hands of Captain Samuel Dewey, and was by him named the "Oninoor," or Sea of Light. John Morrissey once loaned six thousand dollars on it, but, owing to its poor color, and other imperfections, it probably is not worth more than ten per cent. of that amount to-day. A number of diamonds weighing one carat each, have been found in North Carolina, at various times, from 1846 up to the present time. They are usually found in the gold washings, associated with gold and other rare minerals. This *debris* is usually the result of the old gneissoid, and perhaps, the decomposed peridotite rocks. A diamond weighing 4⅓ carats was found on the Alfred Bright Farm in Dysartville, McDowell County, North Carolina, in the summer of 1886, by the twelve-year-old Willie Christie, who was sitting at a spring, and saw "a pretty trick" about two feet from where he was sitting. He picked it up, took it home, and laid it on a shelf. Only after two weeks, did he think of taking it to any one for identification. It was then sent to New York for valuation. It is quite perfect, but has a faint yellowish-gray tint. These facts were authenticated by the writer on the spot. A number of small stones have also been found in or near the elastic sandstone belt in Georgia, most of them in the gold washings of Hall County. Here, about forty diamonds have been found, many of which were of fine quality. These diamonds are usually met with in the refuse of sluice-boxes and "long toms" used in mining operations. California has furnished them in many localities. Professor F. Woehler, of Göttingen, Germany, discovered microscopic diamonds in the platinum sands of the Trinity River, and in all the northern counties of the State, drained by the Trinity River; also in Coosa Bay, Oregon, and in Smith River, Del Norte County. Instances have occurred where fragments of broken diamonds have appeared among the *debris* cleaned from the stamping-batteries, which reduce gold ore. At Cherokee Flat, since 1853, from fifty to sixty diamonds have been found: the largest one weighing 2¼ carats, some of them rose-colored, some yellow, and some white. The highest price that has ever been paid for a California diamond in the rough is five hundred dollars.

The probable origin of the South African diamond is explained by Cohen, Roscoe, and Lewis as derived from an eruptive rock, which was forced through beds of carbonaceous shale, thoroughly breaking up the carbon, so that it was disseminated through the volcanic rock, from the size of a pin point to large masses. This heating of the shale, had released, as Roscoe found, a volatile hydrocarbon, from which he thinks the diamond was formed. A

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similar volcanic rock, containing a carbonaceous shale. was found in Elliott County, Kentucky, by Mr. J. S. Diller; and the possibility of diamonds being found there, was suggested by Professor Carvill Lewis, and led to a systematic search by Mr. Diller and the writer, under a mission from the United States Geological Survey. Diamonds were not found, and the shale was found to contain only 1-35th as much carbon as the South African rock. Still there is a possibility, that the eruptive rock may have penetrated richer layers of the carboniferous and Devonian rocks elsewhere.

Of the corundum or sapphire gems, more than fifty have been found at the Jencks Mine, Franklin, North Carolina, where corundum mining was carried on some years ago, and has recently been resumed to supply mineral for a grinding or polishing substance. Fully one-half of these were really gems in every sense of the word. Some ruby-red ones were of a fair color. The blue sapphire and some fine violet-blue, light red, pink, and yellow sapphires, were also found. None of these gems had a higher value than a hundred dollars. An emerald-green sapphire (Oriental emerald), measuring 4 by 2 by 1½ inches, that would furnish from 80 to 100 carat weight of gems, the largest being about 20 carats in weight, is now in the cabinet of Mr. Clarence S. Bement, with the choicest crystals found at this mine. The gem is one of the rarest known. It will not be cut, however, since its owner prizes it much more highly in its natural state. This locality has also furnished some fair *cabochon* rubies, weighing over one carat. Vernon, New Jersey, has furnished some crystals of sapphire and ruby, which are brilliant though opaque, thus possessing little commercial value. The largest known crystal of sapphire came from the Jencks Mine about 1872. It weighed 312 pounds, and was both red and blue, ruby and sapphire, in color. It is now in the Shepard collection at Amherst College, and was considerably injured in the disastrous fire of 1882. Rubies and sapphires, always more or less opaque, have been found at many localities in North Carolina and Georgia.

The finest sapphires for gems, are collected by the miners from the sluice-boxes of the placer mines near Helena, Montana. The gems are usually light green, blue, red, and all the intermediate shades. One of these rough crystals is shown in Fig. 2 of the plate. Often they are blue, as viewed in one direction, and red when seen in another. Frequently all the colors would assume a red hue by artificial light. A very interesting piece of jewelry was recently made from these stones in the form of a crescent. At one end, as seen by daylight, the stones were red, shading to a bluish-red in the centre, and finally into blue at the other end; but by artificial light the color of all turned red. A few small gems less than one carat in weight, have come from the same place that were truly ruby red and sapphire blue. Of the latter color, perfect gems have been found here up to nine carats in weight. By artificial light these are intensely brilliant.

The colored plate shows (Fig. 3) the first sapphire ever found in its original matrix. It consists of the stone from which a kernel of blue sapphire had dropped out. This kernel was then cut, and replaced in its original matrix. A white band running across the centre of both, shows conclusively that it belonged there. It was mined by Colonel C. W. Jencks, at Franklin, North Carolina. Near this place, brown crystals of sapphire have been found, in which, when they are cut *en cabochon*, so that the dome of the cut stone is parallel with the perpendicular axis of the crystal, an asteria effect is produced, but not as fine as the Oriental.

Spinels of a smoky blue, velvet green, and dark tinted claret-color have been found in gems weighing about two carats each, near Hamburg, New Jersey. Some fine ones weighing about two carats each, were unearthed in San Luis Obispo, California. Twenty years ago, somewhere between Monroe and Southfield, Orange County, New York, a deposit was known only to two persons, now deceased. The locality was worked secretly for some years by

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moonlight, and from it were obtained the finest crystals of spinel that the world has ever known, some of them over six inches in diameter.

Many fine crystals of topaz have been found at Platte Mountain, near Pike's Peak, Colorado, during the last three years. In appearance they generally vary from clearly transparent to a rich cinnamon brown, and a few are light blue or light green, one of these gems weighing 193 carats. The fac-simile of this one is given in Fig. 4 on the colored plate. These gems are equal in quality to the finest of the same size from Siberia. Some beautiful pellucid white crystals have been found in some isolated mountains west of Sevier Lake, Utah; and Stoneham, Maine, has furnished a few small gems, and opaque crystals one foot square.

Among the beryl gems, emerald and aquamarine, the finest are those which for the past twelve years have been found in the soil of Alexander County, North Carolina, and called by the farmers, "green bolts." Some of these were sent to Northern mineralogists by J. A. D Stephenson as early as 1875, and a company was formed for the purpose of mining them, under the superintendence of Mr. W. E. Hidden, and they have carried on mining operations from time to time at this locality. The largest crystal (the central illustration of the colored plate, Fig. 5), measures eight inches and a half in length, and is the largest emerald crystal known. This, with several other exceedingly fine ones, is in the Clarence S. Bement collection. The crystals, as a rule, have a white core; and although as crystals they are grand, few gems, and those very light in color, have been found.

Aquamarines, beryls, pure white, light blue, and light green, are native to many localities in the United States. One, flawless, of fine color, and weighing 133¾ carats, was found at Stoneham, Maine. The beauty of this specimen may be judged from its copy in Fig. 6 on the plate. Two fine deep blue gems from Royalston, Maine, in the National Museum collection of gems, weighing 10 and 14 carats respectively, and another from Portland, Connecticut, are of fine quality, and equal to the deep blue Brazilian ones. Some clear white stones are sold by the local jewellers at Fitchburg, Massachusetts; and within the past few years, some thousands of dollars' worth of yellow beryls have been cut, and sold as "golden beryl," from near Litchfield, Connecticut. A cut specimen of this gem appears as Fig. 7 in the plate. A few small, rich, yellow stones were also found at Round Mountain, Albany, Maine. Some fine golden yellow beryls, several weighing 20 carats each, have been found at the Avondale quarries, Delaware County, Pennsylvania. Six fine beryls, weighing from one to four carats, were lately found by B. B. Chamberlain at Manhattanville, New York.

The rare gem phenacite has recently been located near Pike's Peak. These gems are colorless or pure white, and match the Siberian ones in purity and transparency, but their value as gems is purely mineralogical.

The finest garnets in the world are those found near Gallup, New Mexico, Fort Defiance, Arizona, and Helena, Montana (see the three specimens numbered 8 in the colored plate). They are often associated with oily green and olive green peridots called "Job's tears" (see the rough and cut specimen given as Fig. 9 on the plate) on the surface of ant-hills, where they have been carried not only by the ants, but also by the scorpions. They are there called rubies. Although the garnets found in the diamond mines at the Cape of Good Hope, (the so-called "Cape rubies") are larger in size than these, and perhaps by daylight equal to them, there are undoubtedly no garnets found that appear better in the evening and by artificial light than those from the United States. The dark color of the Cape garnets remains in artificial light, whereas the American garnets show only the clear blood-red hues. The color of these is usually a rich red, but very often purple or almandine, and sometimes approaching to the tint of honey. Many thousand dollars' worth of these garnets have been disposed of. They are rarely larger than three carats each. Fine garnets are also found in North Carolina, Pennsylvania, and New England.

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The tourmalines from Maine have long enjoyed a world-wide renown as the finest known. Crystals over eight inches in length have been mined, but unfortunately, many have been injured, either by weathering or by blasting. A fine white cut achroite of 23 carats, a fine ruby-red tourmaline of over 20 carats, some green of over 25 carats; and a large number of almost all conceivable colors, are in the Hamlin and Shepard collections. The former contains the finest series of this gem in the world, and would furnish full suites for a dozen cabinets. The original of Fig. 10 is in this collection. At this locality are crystals white at one end, shading into green, then light green, and finally red at the other end. We find here also the interesting occurrence of a green outer crystal enclosing a white one, within which is a red or blue centre (see Fig. 11). The gems from this locality would amount to many thousands of dollars in value. Auburn, Maine, has also furnished a number of light blue, and the principal lighter shades of blue and pink gems, but none over 10 carats in weight. Explorations at Newcomb, New York, during the last summer, brought to light many fine brown and yellowish crystals, some weighing several carats, which are the finest yet discovered in this country, and closely resemble the brown gems from Carinthia, Austria

The greenish-yellow and green mineral supposed to be diopside, and sent by Mr. W. E. Hidden to Dr. J. Lawrence Smith, the latter identified as a new variety of spodumene, and named it "Hiddenite." It was originally found by Mr. J A. D. Stephenson, It is a silicate of alumina containing seven per cent. of lithia. Its hardness is 7. Only limited quantities of it have been found. Since it is a beautiful gem, and of purely American origin, some stones have sold at over a hundred dollars per carat; but, on account of the small quantities found, it was only purchased in the United States. It possesses a peculiar brilliancy of its own, although its color is not an emerald green. The finest crystal found is copied as Fig. 12 on the plate.

Crystals of quartz (rock-crystal) are found abundantly in many localities in the United States. At least, a hundred wagon-loads are annually sold at Hot Springs to the local tourists, as are also rolled pebbles that are found on the banks of the Washita. The scarcity of the latter and the lively demand for them have awakened the cupidity of the farmers, so that they have learned to make rolled pebbles by placing a number of crystals in a box that is kept revolving a few days by water-power. These are purchased by tourists, and cut into mementos The beautiful crystals of Herkimer County, New York, and of Lake George are familiar to most people. These small, exceptionally perfect crystals, have been collected by the hundred thousand at these places. At times they are as brilliant, transparent, and perfect as any known substance, not excepting even the diamond. They occur in curious groupings, and often include small specks of bitumen and pearlspar. They often enclose fluid drops with moving bubbles, which contain two carbonaceous substances, one of which sinks and the other rises as the crystal is turned. North Carolina has furnished masses of transparent crystal over two inches and a half in diameter. From Alaska, a 10 pound piece of a rockcrystal has been cut into clear crystal slabs for hand-mirrors, three and five inches in diameter. The most remarkable locality for rock-crystals is that recently visited by the writer in Ashe County, North Carolina. On of these weighed 285 pounds, being 29 inches long. A perfect one weighing 22 pounds is the finest piece of rock-crystal that has been found in this country. Another fine crystal, large parts of which were clear, weighed over 300 pounds, but was unfortunately smashed by a Herculean twelve-year-old mountain girl. Fine crystals measuring from six to eight inches in diameter, that would afford crystal dishes clocks, and other objects of luxury, have been procured here.

Amethysts sufficiently perfect to be cut into gems, have been found at Stow, Maine. The colored plate shows the finest one from this place (Fig. 13). The most remarkable amethyst found in the United States has been deposited by

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Dr. C. E. Lucas in the National Museum. It is a turtle-shaped, prehistoric, clipping two inches and three-quarters in length, two in width, and an inch and a half in thickness. It is almost flawless, and would afford a fine gem.

At the Yellowstone National Park and at Holbrook, Arizona, amethysts line the hollow trunks of agatized trees. They are usually too small, however, for gem purposes. Large quantities of the smoky quartz from Pike's Peak region have been sent abroad for cutting. Transparent crystals over a foot long and five inches in diameter have been found. Through the West, this material is familiarly known by the name of "cairngorm" or "smoky topaz" (see Fig. 14 on the plate). The plate shows a common tint. Rutile in quartz, *flèches d'amour* (love's arrows), or Venus's-hair-stone, as it is called, is found in a number of localities in the United States, the principal supply coming from North Carolina. This pellucid quartz is penetrated in all directions by red, golden, and black rutile, in the form of hair-like crystals, ramifying through the stone in every direction. It is made into a great variety of gems, and ornaments. Probably the finest specimens were those found in 1847 near Middlebury, Vermont. They were of a rich red color, six inches long and three inches wide, and penetrated by many rich, red, and yellow crystals, from the thickness of a knitting-needle to that of a thin lead-pencil. From Rhode Island are obtained pieces of quartz penetrated by black hornblende, quite equal to anything found elsewhere.

Agate, chalcedony, cornelian, silicified woods, and also jaspers, have been found in an endless variety in many American localities. Fine agate has been found at Agate Bay, Lake Superior, and in most of our Western States. The silicified woods from Arizona, rich varied in color, are perhaps the most remarkable in the world. Sections of trees, twenty-nine inches in diameter, were recently cut for table tops at Sioux Falls, Dakota. The magnificent moss-agates from Wyoming, Montana, Colorado, and Utah, have been sold all over the world. When the stones were fashionable, many of them sold at over ten dollars each, as much as twenty thousand dollars' worth being sold in one year.

Banded jasper, white, yellow, and red, in masses from four to six inches across, comes from Collyer, Kansas. Beautiful blood-stone, or heliotrope (green jasper with red markings), is produced in Howe County, Georgia. Red and yellow jasper has been found at a number of localities in the United States—at Diamond Hill, Cumberland, Rhode Island, along the Hudson River from Troy to New York, and especially at Hoboken and Fort Lee, where there is a jasper outcrop. Beautiful green chrysoprase has been discovered in the nickel mountains of Oregon. The fire opal, without much opalescence, is obtained in Washington County, Georgia. Beautifully colored opalized wood abounds at many localities in California.

An opaque white hydrophane (a variety of opal) has been found in Colorado, that, from its curious property of becoming *entirely transparent* when water is dropped on it, has been named by the finder "magic stone"; and he suggested its use as a stone for seal rings, scarfpins, or lockets, where it can be put over a photograph or other object, and when enough water is absorbed, will reveal the concealed object. It absorbs its own weight of water.

Turquoise is found at Mount Chalchihuitl, Los Cerillos, Santa Fe County, New Mexico, and at Mineral Park, Mohave County, Arizona. Almost without exception, all the gems from this locality are apple and pea green. Occasionally the gems are blue, but this is often changed after a slight exposure. Some of the green stones are often stained, so as to resemble the more valuable blue ones. Turquoise is used in jewelry only for special purposes. The New-Mexican green turquoise was highly prized by the aborigines for ornament. The turquoise in both New Mexico and Arizona, like that from Persia, occurs in veins throughout masses of yellowish trachyte, and many tons of rock may be broken before finding a valuable stone. The colored plate (Fig. 15) shows a rough pecimen as it came from Nevada. In both of these districts the waste and

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debris excavated in former workings are very extensive, and on the slopes and sides of immense piles of rubbish are growing cedars and pines of great age. Along the line of the railroad turquoise is sold to some extent by the Indians of the San Domingo Pueblo, New Mexico. The stones are ground into round or heart-shaped ornaments, which are drilled with a crude form of bow-drill. The drilling point is made either of a chip of quartz or agate, and the wheel, to give it velocity, is sometimes made as in this illustration from the bottom of a bowl. The price of these turquoises is now very low. One choice string, made up of many hundreds of these stones, was valued as the equivalent of a pony. The contents of a mouth, where the Indians usually carry them, can be obtained for from twenty-five to fifty cents. Turquoise was used by the ancient Mexicans to incrust human skulls, and to inlay mosaics and ornaments made up of obsidian, and also, together with iron pyrites, for making mosaic inlays and incrustations, forming many rinch and curious effects.

The rich green Amazon-stone from Pike's Peak, Colorado, enjoys a world-wide reputation for the magnificence of its rich green crystals, although it is very sparingly used in gem form. Beautiful sun-stone and moon-stone have been found in Chester County, Pennsylvania, and also in Amelia County, Virginia. Immense quantities of obsidian (volcanic glass) occur in Colorado, Nevada, and California, and a ledge over half a mile long crops out at Obsidian Cliffs, Yellowstone Park. Brown and black obsidian, when mottled, is called mountain mahogany.

Beautiful labradorite has been found in the rocks and bowlders of a stream in Essex County, New York, which is accordingly named "Opalescent River." It is extensively quarried for ornamental purposes, and some exquisite pieces are cut as gems. Beautiful blue crystals of transparent kyanite, as fine as any of these precious stones from St Gothard, have been lately brought to light in Mitchell County, North Carolina.

The magnificent American rutiles (pure titanic acid), in their variety of forms, lead the world. Magnificent large crystals, of which some have been used as gems, have been found at Graves Mountain, Georgia; and at several localities in Alexander County, principally near Stony Point, North Carolina. This rutile, when cut, more closely resembles the black diamond in color and lustre than any known gem possessing all the desirable features of a rich mourning gem. Some of the crystals are almost blood red by transmitted light. Sodalite, deep blue and azure blue, resembling lapis lazuli, has been discovered at South Litchfield, Maine, in masses over one inch square, and has been cut into gems. Rhodonite, a silicate of manganese, which is extensively used in Russia for jewelry, was obtained at Cummington, Massachusetts, in fine large pieces of rich flesh red color, occasionally beautifully streaked with black oxide of manganese, and equal in every respect to the finest from Russia. Willemite (silicate of zinc), a mineral occurring in any considerable quantities only at Franklin, New Jersey, is there mined as an ore. A number of gems (about ten in all), some of them eight carats in weight, have been cut from this material. The color is a rich canary yellow, with a vitreous lustre.

Chlorastrolite (a silicate of alumina, lime and iron), occurs on the shores of Isle Royal, in Lake Superior, in small, rounded water-worn pebbles, which fall from the trap-rock as it disintegrates and is extensively sold as a gem in that region. It is of a peculiar light grass-green color, and is finely radiated or stellated in structure. It is one of the most pleasing of our purely American gems. The largest, from Mr. M. T. Lynde's cabinet, is represented above.

Lodestone, a magnetic iron ore, although not worn as a gem at present, for centuries has served this purpose, especially when gems were used for the powers they were supposed to possess. The strongest in the world is found in large quantities at Magnet Cove, Arkansas, and at present hundreds of pounds are annually sold by druggists, especially to the Southern colored people, for various purposes, principally as a preventive for rheumatism, but also as a conjuring stone. Only in July, 1887, a case was tried in Macon, Georgia, where

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a piece had been sold for five dollars to a colored woman, as a charm to bring back her wandering husband. The man still remained away from home, so she sued the doctor, and as the market price for the magnet was only seventy cents a pound, the judge ordered the money refunded.

Thomsonite is another of the Lake Superior gems. Its color is flesh red with zones of green, red, and white, resembling the eye-agate. Like the chlorastrolite, it is weathered out of the trap-rocks of the region, and is extensively sold. Many fine varieties of serpentine are found in the United States. Williamsite, from Texas, Pennsylvania, is a new apple green variety.

The fossil corals, so extensive through the limestone of Iowa, are extensively cut, and polished by the local collectors and jewellers, and sold all over the United States. Malachite occurs in seams from three to four inches in thickness, and covering surfaces over a foot across in the Globe copper mines in Arizona, as also in beautiful mammillary and radiated masses of sufficient thickness to be used in the arts, and equalling that from Russia, although not so plentiful.

Amber has been found at a number of American localities, but unfit for use in the arts. A mass weighing twelve ounces was washed out of the tertiary deposits on the shore of Nantucket, Massachusetts. A piece twenty inches long, six inches wide, and one inch thick, weighing sixty-four ounces, was dug up at Kirby's marlpit, near Harrisonville, Gloucester County, New Jersey. Traces have been observed in North Carolina and in Alaska. Beautiful jet has been found in El Paso County, Colorado. It has been quite extensively sold for specimens, and rivals any known jet. Masses one foot long, four and five inches wide, and an inch thick, admitting of a fine polish, are not uncommon. The greater hardness and cheapness of onyx have almost entirely superseded the use of jet in the United States. The beautiful arrow points found in Oregon, which are made of rock-crystal, flesh-colored and mottled jasper, or various colors of chalcedony, are sold to some extent for mounting in jewelry as well as for cabinets. These are of small size, but of great beauty, representing the highest skill of savage stone-chipping, aside from the value of the gem materials. Three of these specimens are shown as Fig. 16 on the plate.

Pearls are produced in some of the unios (fresh-water mussels), of which there are many hundred species, especially those found in the fresh-water brooks traversing a limestone country. The first pearl of any note was the famous "Crown Pearl," found by a shoemaker, Daniel Howell, while collecting some of these mussels in Notch Brook, near Paterson, New Jersey. This was purchased by Messrs. Tiffany & Co. for $1,500 in 1856, and led to the great pearl excitement. Millions of unios were collected, and many thousands of pearls found, and some of them very fine ones. One, however, which weighed nearly four hundred grains, and would perhaps have been the finest pearl of modern times, was destroyed by cooking the mussel.* They have since then been fished out as far west as Ohio. At Waynesville and other places on the Little Miami River many fine pearls have been found, and more recently fine ones have been found in Kentucky. Tennessee. and Texas. One single firm has purchased over $100,000 worth of pearls found east of Texas. The pearls are rarely entirely round, usually a little oblong, button-shaped, flat on the back and imitating every conceivable form, such as beetles, fish, bird wings, and often have had this feature assisted in the mounting of enamel and gold, after the manner of Dinglinger pearls at the famous Dresden Green Vaults. The color is rarely a true white, usually pink or bluish, often iridescent. The nacre is smoother, if anything, than in the Oriental pearls, and they are often more beautiful; single pearls have been sold for over $2,000. The "Crown Pearl" above mentioned is shown in Fig. 17 of the colored plate.

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* And yet a pearl collector in Western Australia informed us that the meat of pearl-yielding shells was boiled before being searched for the gems.—COMPILERS.

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Only one pearl of any kind is tound in a hundred shells, and usually one in a thousand of any value, so that it is not a very profitable pursuit. The indiscriminate killing off the mussels in fishing and by poisonous sewage will eventually lead to their extermination. The greatest destroyers, however, are the hogs, which kill off whole banks in a single low tide. Pearls are also secreted by the common hard-shell clam (*Venus mercenaria*); these are usually white, tinged with purple, or almost black. The latter colors are preferred, although they have little value. They sell at from $1 to $100 each, and are found as large as a hazel nut. The common conch (*Strombus gigas*), fished extensively on the Florida coast for bait, often contains the so-called pink pearls. Although they are not true pearls, they have sold at $1,000 each. Our oyster pearls have neither value not beauty.

"GOLD IN CEYLON," BY AN OLD AUSTRALIAN DIGGER.

To the Editor of the "Ceylon Observer."

20th January 1888.

Dear Sir,—The many notices we see in the newspapers of finds of gold in so many parts of the world surely ought to induce those in power to move in some manner to develope our own island gold fields. Ceylon Gold fields you may think audacious words to use, seeing we have never had any gold, mining worth the name. Perhaps so, but let me remind you, that gold has been found in several parts of Ceylon, notably in Sabaragamuwa. That all the beds of rivers and rivulets about Ratnapura, for miles and miles are auriferous, si wellknown, whether in payable qualities has never been proved, because never tried. Is it likely that the beds of the rivers only are auriferous? I think there is good reason to suppose that leads and scattered deposits of gold, might be found all through the plains for many miles above, below, and to the south of Ratnapura, and at depths probably averaging the depths of the beds of the rivers. That Mr. J. W. Home and Mr. Minto worked for a time at the back of the Ratnapura jail, and barely got gold to cover half their costs, proves nothing other than that gold was there. An Australian miner would have considered the prospects ample, to warrant a thorough trial, besides, I do not suppose that Home and Minto had either mining experience or proper appliances. Next to auriferous soil, experience is everything in gold mining. Many years ago Mr. Saunders, when stationed at Ratnapura, did all he could to have it thoroughly tried, but was discouraged and defeated by the then Government who feared that gold mining breaking out, might be too revolutionary and not conducive to their own ease. A more auspicious time to revive the question could not be found than the present. We have one of the ablest, wisest, strongest-minded Governors that ever ruled Ceylon. The Government Agent, Western Province, and his energetic lieutenant at Ratnapura are the right men in the right places, to carry out what to many would be unwelcome innovations. To add to these, we are entering on the dry season, which ought to be taken advantage of. There is a dark side to the question—certainly which cannot be ignored—and which makes it necessary, that Government move first in the matter. The country all about bears no auriferous appearances. Water below and floods above, would be to contend with, and much of the land is in private hands. A sufficient quantity of gold would overcome these difficulties, but they are too great for private enterprize to begin, and Government ought to hold out some inducement. You should remind them, that little Victoria was able to export 100 tons of gold annually for many years; that their gold fields enabled them to give out their first railway contract £3,000,000, the then largest railway contract in the world's history.—Yours, A. B. C.

[We want an officer of the Indian Geological Staff to surve Ceylony geologically.—Compilers.]

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GOLD IN CEYLON.

"Gold, yes, there can be no doubt that it exists in Ceylon, and may yet be found in paying quantities in quartz reefs. Mr. Blackett took specimens from one reef on Dotel-oya estate and had them assayed at the School of Mines in Ballarat, and they averaged 3 *dwts.* and 5 grains to the ton. Many of the Australian mines were made to pay their way with less with our cheap water-power during the wet weather, 2 *dwts.* per ton should pay."—*Cor.*

[We should welcome Australian capitalists bringing the needful experience as well as money to open reefs in Ceylon, and they ought certainly to send an expert to examine and report on Mr. Blackett's reefs.—COMPILERS.]

An Ambagamuwa correspondent writes:—"There is gold in Ceylon in paying quantities. There should be some steps taken to make practical use of it, and give a filip to the island. Stones I have sent home, none of the best, in fact they were not sent home for gold analysis at all, gave 1 dwt. 10 drachms per ton gold and 3 to 4 drachms of silver per ton.

"The gentleman to whom it was sent said, most likely under the limestone we should come across better, but would advise no expense to be taken as it might not pay for the trouble, but that a landslip might discover it. I know another place, *not here*, but lower down, which have 3 dwt., and Ramboda 3 to 4 oz. per ton, I believe. Strange, I find the most pyritiferous stuff about my limestone reef.

"I have an idea our limestone is permian, and that the plumbago in Ceylon is not true primary plumbago, but metamorphic coal.* I spoke to Dixon about it, and he said he thought my idea was correct, and Ceylon was not primary metamorphic, but of a later date. Gold has been worked in Australia when found in less quantities than I find it here.

"You may say, what do I know of geology? *Practically but little;* I am very fond of it. I have read Lyell's Elements through two or three times, and others of Lyell's the best on metamorphic rocks over and over again. I have read all Professor Darwin's works over twice, and everything else I have got hold of in geology. What to me appears we must go deep in Ceylon to find anything or close on to the primary granite. There we most likely will find the most metal; the washings at gem diggings are not of much value, as they sift the stones and as our gold is fine, it is all lost. I am a firm believer in gold in Ceylon.

"I have got here from pyrites visible gold with the blowpipe. Dickson said some pyrites I sent him had at the rate of three or four ounces to the ton in them, but he was so little to be trusted! He said we here were much like Ramboda. There is gold somewhere about, and I have seen indications of it in Lower Maskeliya, stronger than I have in this; also in Lower Dikoya. I feel sure I know a place would be well worth prospecting."

"The large pyrites, nearly 1 cwt., which Dixon said had some 3 or 4 oz. of gold in it, was from a broken gneiss boulder from over the limestone reef. Our gneiss here is extremely pyritous, and the best tests for gold I have had with chloride of tin have been from gneiss. I know of a thick band of gneiss not far from here, one mass of arsenical pyrites, also some other stuff, copper, I think, as it cuts with a knife. Arsenical pyrites is a sure accompaniment of gold in Australia. We have every indication of gold here. The only wonder is we do not find it visibly. They say we have not slate; no, but we have mica schists or rather metamorphic slate by intense plutonic action. A piece of stuff I had sent me from the Del Rey mines in Brazil was only black gneiss, and no gold is visible to the eye. I believe in highly metamorphic rocks, more or less primary. Gold is found in the gneiss, or rather black veins,

* "Metamorphic coal!" All coal is metamorphosed vegetation.—COMPILERS.

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metallic in the gneiss, not quartz. Why not here? As I have said, the gneiss is far more pyritic than the quartz, and I firmly believe if we were to look for gold in it we should find it."

(*From a Galle Correspondent.*)

Mr. A. D. Dominico, who is at present engaged in gem digging in the Matara district, is of opinion that gold exists in Ceylon. Some years ago while prospecting for gems in the Western Province, he came across traces of it in alluvial soil. He also learned that some native gem diggers had discovered nuggets which had been converted by them into jewellery, and was so impressed with the idea that he solicited Government aid to help him to carry on mining operations for 6 months. Government however declined to entertain the project, and the scheme fell through. Mr. Dominico is still very sanguine on the subject.

[Gold is simply about the most widely distributed of metals, and is of course found in many places here; but the question is to get it in paying quantities, and for that we must go to the matrix in the rock.—This closes the matter we are able to get into the present edition of "All About Gold, Gems and Pearls" to which we must now refer all interested, for full information on the subject of "Gold in Ceylon."—COMPILERS.

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GOLD IN SOUTHERN INDIA.

(London "Times," Jany. 20th, 1888.)

A meeting of the East India Association was held yesterday afternoon at Exeter-hall, when a paper on "The Goldfields of Southern India" was read by Sir Roper Lethbridge, C.I.E., M.P. The chair was taken by Lord Harris, and among those present were Sir Richard Meade, K.C.S.I., Mr. Hyde Clarke, General Lowry, C.B., Mr. C. W. Arathoon, General Wade, Colonel Byrde, and General R. M. Macdonald.

Sir Roper Lethbridge, in the course of his paper, pointed out that the great and all-important difference between the Australian goldfields and those of India was to be found in the fact that when the former were discovered they had hardly been trodden by human foot, whereas the latter had been the seat of a dense population and of a high civilization from time immemorial. In Australia the English and Californian diggers found the gold much as nature had left it, not only in the rocky matrix, but cast up and expressed in the form of nuggets, and permeating great alluvial deposits or "placers." In India centuries of industrious toil and minute research had long ago removed all surface gold; wherever the old miners could get out the auriferous quartz by quarrying, they had done so, and the only limits imposed on them had been due to their ignorance of those engineering appliances by which mines were drained, ventilated, &c., as well as of those chemical means by which the ores were treated. On the other hand, the gold-bearing rocks of India seemed to be, on an average, far richer than those of Australia or America; and it was now fully established, on official evidence, and from innumerable private investigations, that many of the auriferous reefs of Mysore, even at shallow depths, could yield one, two, and even three ounces per ton on an average of large quantities of crushings. In the course of the next few weeks the number of stamps at work on the "Mysore" mine would be exactly doubled, as 30 new stamps were now almost ready for work. To estimate its value it would be useful to turn to the experience of Victoria. Between the years 1860 and 1876, the average outturn of all the mines in Victoria (some of course giving more, some much less) was 11 dwts. 6·30 grs. per ton, the average for the year 1876 being 10 dwts. 13·48 grs. per ton, and the average for 1886 a little over 12 dwts. The Black Hill Company, at Ballarat, crushed 283,550 tons in 1876, with an average of 2 dwts. 23 grs. per ton, and paid dividends amounting to £23,000. And other companies in Victoria in that year paid dividends on outturns of 2 dwts. 13·4 grs., 3 dwts. 6·01 grs., and so on. In Mysore labour was far cheaper, fuel, timber and carriage were more abundant than in Victoria; and, in fact, as Mr. Brough Smyth said of the Wynaad, "the country presents the greatest facilities for prosecuting mining operations at the smallest cost." He added that "the facts will speak more strongly than words to those acquainted with gold mines. . . . The reefs are very numerous and they are more than of the average thickness of those found in other countries; they are of great longitudinal extent, some being traceable by their outcrops for several miles; they are strong and persistent and highly auriferous at an elevation of less than 500 ft. above the sea, and they can be traced thence upwards to a height of nearly 8,000 ft., and near them gold can be washed out of almost every dish of earth that is dug." All these were, as Mr. Brough Smyth put it, plain facts; their absolute accuracy had been abundantly proved since his time; and his conclusion, therefore, seemed to him to be entirely justified—"It must be apparent to all who have given attention to this question that, sooner or later, gold-mining will be established as an important industry in Southern India." Eight years had elapsed since the above words were written, and now at length, with the actual success of the Mysore Company, with the rich promise of a large number of other mines, with a friendly and prosperous Government determined to develop the mines by every encouragement

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in the way of railway and road communication and liberal mining rules, and, above all, with the results before them of the examinations both of the local officers and of the representatives of the Imperial Government, he thought it might at last be said that Mr. Brough Smyth's prediction had come to fulfilment. At the time when he wrote the kingdom of Mysore, from a geological point of view, was almost a blank. They knew, indeed, from the talk of the countryside, in a vague sort of way that extensive mining had been carried on. And they also knew that over large tracts of country certain tribes of natives were still in the habit of washing for gold; indeed, it was said that every old woman, in some parts of Mysore, was in the habit of earning a few annas a week by gold-washing.* The famous Dewan Purnia had tried mining on a somewhat more ambitious scale at Bellibetta, "the Hill of Silver," in the Taluk of Attikuppa, and elsewhere; and even in General Cubbon's time it had been found necessary to prohibit mining on the Kolar field, because in a mine near Ooregum 15 miners had suddenly come upon old workings and had been entombed in them. All these things were vaguely known; and in 1873 Mr. Lavelle had actually obtained permission from the Mysore Government to prospect for gold, and had subsequently commenced mining near Ooregum, and the association known as the Kolar Concessionaires had been formed to work Mr. Lavelle's concessions. But it was Mr. Brough Smyth's inquiries and reports that attracted public attention prominently to the auriferous tracts. Since then hundreds of ancient mines had been explored, and the process of re-discovery had apparently even now only just commenced, for Mr. Bruce Foote had over and over again, in the course of a "flying run" through the gold fields, come unexpectedly on the workings of the old miners concealed in the jungle that had overgrown them. Since then, too, the industry had run through the phases that seemed incidental to the establishment of mining in any country; it had had a period of insane speculation and absurd mania, followed by the inevitable crash of ruin and disappointment,, and that again followed by a period of slow and painful growth, with crippled means and frequent fears and doubts, leading up finally to such success as that of the Mysore Company, which had recently produced gold to the value of £8,299 8s. 4d. in one month with 18 stamps at work, and which, in a few weeks, would have 60 stamps continuously at work on ore that not unfrequently assayed up to 2 oz. and 3 oz. per ton, and of which the supplies actually in sight were practically inexhaustible. Of course the veins were found sometimes to pinch and become smaller in size; and sometimes the ore was found to be less rich. Every geologist and every miner knew that this must be the case, and knew also that where the veins were "true fissure veins" the better and richer conditions were practically certain to recur, and even to improve as greater depth was attained; so that he ventured to say that the Stock Exchange panics and the excessive depreciation of shares that sometimes occurred were utterly foolish and unreasonable. To the managers of the Mysore Gold Company, and especially to Captain Plummer, was largely due the credit of rehabilitating that great industry, just when it seemed absolutely destroyed and all its credit gone. And yet Captain Plummer's secret was no great mystery or invention. It might be supposed that the very sight of vast remains of ancient quarrying would have suggested the advice to "bottom out the old workings and to sink below the point reached by the old miners." And in that —and that alone, if they put aside the tenacity of purpose and many other excellent qualities of Captain Plummer as a leader of men—consisted the superiority of his mining policy, which brought success, over that of so many others, which brought failure. Captain Plummer sank shaft after shaft, not on the old workings, but so as to intersect the lode at or below the lowest point of those workings, and there he had at once come

* The joke is, that an Indian cooly, when he has nothing better to do, washes for gold in the nearest stream and makes his 2 annas a day, and it is on record that a man once made 4 annas (6d.) !—COMPILERS.

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upon unlimited abundance of stone giving over an ounce of pure gold to the ton. The Mysore Company's mine had well and fairly earned the title of "the Pioneer Mine of India;" and the rapid development it was now making must soon bring it into the position of being one of the very richest gold properties in the world. But the only reason of the pre-eminence, and the deserved pre-eminence, of the Mysore mine was that it had been far better managed than others, and therefore was far ahead of all in all branches of development—in buildings, in machinery, in *personnel*, and, above all, in having a vast extent of "stoping" ground actually opened out and brought within reach. Nor should it be forgotten that this last-mentioned branch of development had been carried out by Captain Plummer with so much foresight and care for the future that he had often been blamed by his own shareholders as "mining for posterity." He thought that, considering how far Mysore was from London, and especially how much all the conditions of Indian life differed from those of English life, it was of the greatest importance that a most careful system of inspection and report should be perfected, and that not merely by agents, but by directors themselves, by those who knew India, and by those whose social position would remove them from the temptation of unduly colouring their reports. In short, he thought that no conditions that could be imposed by the investing public could be too rigorous to secure the most punctilious regard for the canons of safe and honest mining. But what seemed to him simply contemptible was for an investor first of all to ignore all the ordinary precautions of an ordinary business man of common sense—to give *carte blanche* to directors to play ducks and drakes with his money, to say not a word while charlatans were being jobbed into the posts of mine-manager, and while these charlatans were setting up telephones and reservoirs instead of sinking shafts, and were coating their copper plates with layers of machine grease instead of amalgam—and then to turn round and say it was the mine that was at fault, that the money thus dishonestly wasted had been honestly spent in "deep prospecting," and thus to give a bad name to a young industry which must, like all other industries, depend largely on its credit and good name. When he went to Mysore last year he had not one pennyworth of interest pecuniarily in any Mysore undertaking. When he had carefully inspected many mines, had seen for himself the vast extent of the ancient workings and the limitless amount of reefs still remaining to be worked, and had learnt from social intercourse on the spot all that was known and believed about the mines by local residents—not only English magistrates and engineers, but all classes of Mysoreans, from His Highness the Maharajah and the Prime Minister down to a humble jalagar, or gold washer—he determined that he would identify himself to the limited extent of his means with the industry. Since then he had become a shareholder in more than one Mysore company. But he had taken very good care to avoid those companies in which there was any fear of charlatans being appointed to the post of mine manager, or of which he had no personal knowledge either of the locality or of the direction. Those considerations which impressed him as absolutely the most conclusive in regard to the value of those goldfields were the belief and policy of the Mysore Government itself, and the testimony of its officials, and, above all, of Mr. Bruce Foote, the representative of the Government of India. Nothing could be fairer or more calculated to win the confidence of capitalists than the steps that had been taken to prove that enterprise, and to demonstrate its lucrative character, by the Government of His Highness the Maharajah under the present high minded and enterprising Dewan, Mr. Sheshardria Iyer. The Maharajah himself took the most enlightened interest in the development of the industry, as he could testify from conversations he had with His Highness when he the pleasure of being his guest at Mysore last winter; and he believed it was no secret that he enjoyed in that, as in other matters, the full confidence and support of the Viceroy and the Government of India. Indeed, the best evidence of that fact was given when Lord Dufferin deputed Mr. Bruce Foote to examine

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and check the local reports. The policy of the present Dewan of Mysore has been exceedingly successful in every department of the State. The finances were not only in a most prosperous condition, showing this year a surplus of 18 lakhs and a general increase under every head of revenue; but it was also only fair to remember that this prosperity had been attained after a most arduous and prolonged struggle with the disastrous results of one of the most terrible famines ever known in history. And it had also been accomplished in spite of some political discouragement incidental to the fact that the change of Government, when for a long-settled English administration was substituted the government of natives of India, had been almost avowedly experimental. Yet he believed that no impartial obser er could travel much in Mysore with his eyes and ears open—could observe the order and contentment of the country, the wise and popular systems of public education, of justice, of public works—without coming away convinced that "the rendition" had proved a wonderful success. They all knew that Lord Dufferin stated that as his opinion last year, after his visit to Mysore; and Lady Dufferin herself told him in Madras, just after that visit, that the system of female education exemplified in the Maharanee's school at Mysore was probably better than anything of the kind in British India. For his own part he was free to confess that what he saw and learnt at Mysore entirely altered his opinions as to the advisability of the "rendition" of the Berars—for he found in Mysore a very considerable colony of English settlers, in the mining and planting districts, entirely contented and satisfied with native rule. His Excellency the Dewan had now definitely settled the terms on which leases of mining land were to be granted. Those terms were on the principle of the Government laying no burden on the commencement of an enterprise further than might be necessary to test its *bona fides*, but profiting by its ultimate success on something like equal terms with its promoters. In respect to the size of the holdings, the liberality of the Mysore Government contrasted favourably with that of the British, in place of the miserable little holdings of 15 and 20 acres, with a *maximum* of 30 acres, granted in the Wynaad and other British Provinces, the Mysore claims were in blocks of half a square mile, and in some cases of a mile and more, thereby affording the fullest scope to the enterprise of the adventurers. And where there were several applicants for the same block—as would henceforward often happen, now that the official reports indicating the richest localities had been made public—tenders would be invited, and the highest tender would obtain the block for a term of 30 years. This year 30½ square miles were put up for public tender in this way, in addition to some six miles granted more favourably on the strength of earlier promises. As the Government of India observed eight years ago, the dangers were from speculative manias on the one side and from ignorance and defective management on the other. From both of these the nascent enterprise had already suffered severely, and it might be hoped that they were like infantile disorders—when once safely got over they did not return. The Mysore Company had outlived them both—it had lately paid 20 per cent. with only 30 stamps at work; it had now 60 stamps, which would all be at work in a few days, and enormously increased supplies of stoping-ground, which ought to double the yield of gold without materially increasing the expenses. And what the Mysore company had done and was doing could certainly be done by honest work and good management on at least 30 other fields of equal promise that awaited similar treatment.

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